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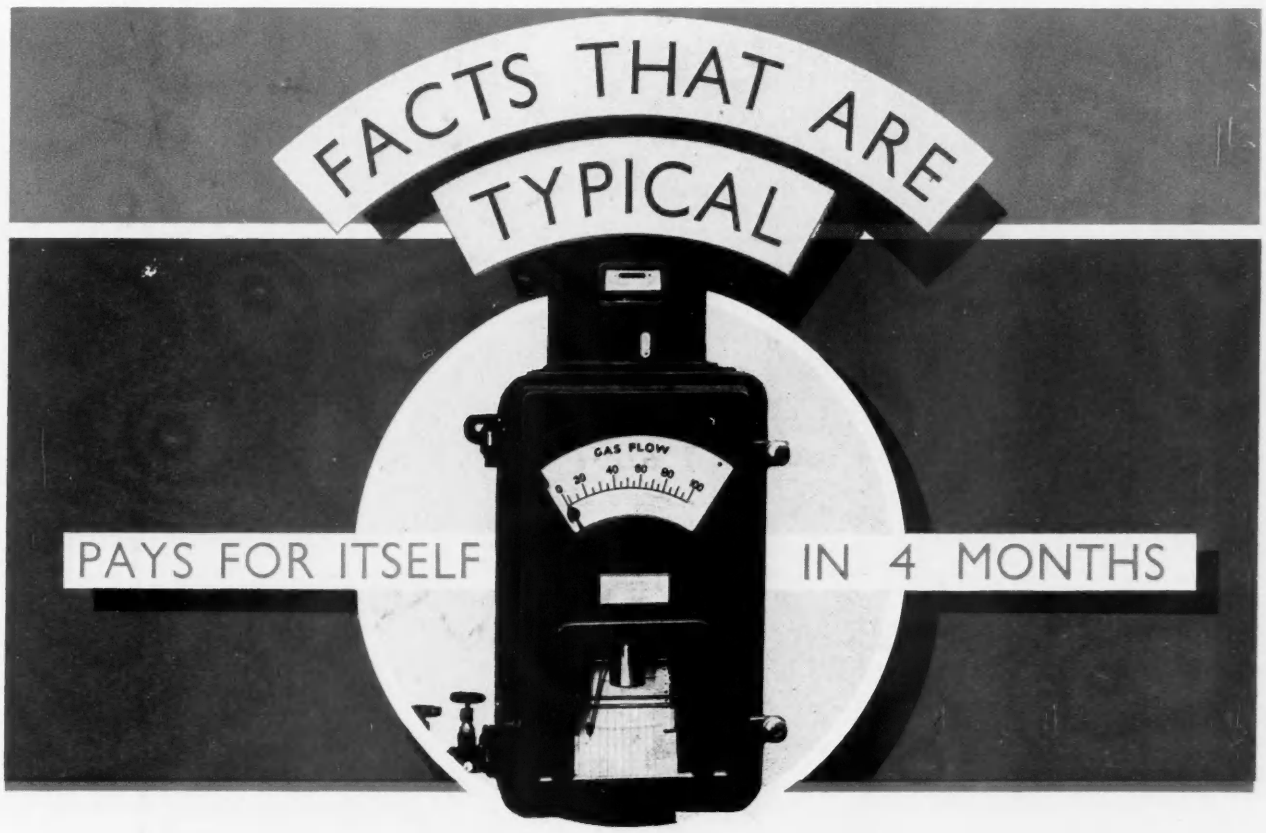

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A Seven-Day Journal

The Jubilee of the Shipping Federation

MONDAY last, September 30th, marked the fiftieth anniversary of the establishment of the Shipping Federation, Ltd., one of the oldest associations of shipping employers. It is much regretted that a public celebration of the event is prevented by the war. The Federation was originally formed as a fighting force, designed to unite the resistance of shipowners to the strike weapon of the Seamen's Union, which was then led by Mr. Havelock Wilson. It was first headed by Mr. G. A. Laws, who was succeeded by his son, Mr. Cuthbert Laws, and for some years the Federation organised strike-breaking on scientific lines. After some years of unremitting war between it and the Seamen's Union a change of attitude set in, which resulted in the recognition of the union and the setting up of a joint constructive policy which was based on collective agreements and the honouring of contracts. The relations between the employers and the unions are maintained through the National Maritime Board, which was established by the Ministry of Shipping during the past war and was reconstituted in 1920, when the Government ceased to have any further part in its affairs. The Board, it may be recalled, has separate panels for navigating and engineer officers, sailors and firemen, and the catering staff. Salaries, wages and welfare are also the concern of the Board, and only three years ago it established a merchant navy officers' pension fund. To-day the Shipping Federation is the one recognised national association of British shipowners for dealing with all questions which relate to seagoing personnel. It has some fifty offices in the principal ports, an apprenticeship department for the recruitment of trainees for navigating officers, a sea school at Gravesend for the training of deck and catering boys, and cookery schools at four different centres for the training of certificated ships' cooks. In recording this jubilee the Federation acknowledges that in none of its work could it achieve full success without the assistance of the other officers' societies, and the National Union of Seamen. The history of the Federation and the Seamen's Union affords another instance of honest opponents becoming firm friends.

Engineer Rear-Admiral William Whittingham

THE death of Engineer Rear-Admiral Whittingham, which took place at his home in Glasgow on Monday last, at the age of seventy-eight, will be deeply felt in Scotland, where he spent many years. He was one of the principal engineer officers in the Grand Fleet during the last war, and he served as Chief Road Transport Officer for Scotland from 1919 to 1921. He was born at Dartmouth and joined the Royal Navy as assistant engineer in July, 1882. After seeing service with the Mediterranean and the Pacific Fleets, he was in 1892 appointed Chief Engineer of the dockyard at Halifax. Three years later he was made senior engineer of the cruiser H.M.S. "Mohawk" on the North American station. In 1899 he was appointed staff engineer in H.M.S. "Pegasus." He went to the Clyde in 1901, when he was appointed Admiralty Overseer at the Greenock Foundry Company, where he remained for four years, and after serving in the cruisers H.M.S. "Argyll" and H.M.S. "Niobe" he returned to Clydebank, where he was Admiralty Overseer from 1909 until 1912. In December, 1912, he joined the staff of Admiral Sturdee in the Second Cruiser Squadron, and on the outbreak of war he was serving under Vice-Admiral Sir George Warrender in H.M.S. "King George V" in the Second Battle Squadron, a ship in which he served until January, 1917. On his appointment as Engineer Rear-Admiral he became engineer officer on the staff of the Commander-in-Chief at Rosyth, a position which he continued to hold until 1918. Admiral Whittingham received the C.B. in recognition of his war services. From 1919 he was Chief Road Transport Officer for Scotland, a position which he held until 1921. After his retirement he made his home in Glasgow at "Glenshire," 266, Nithsdale Road, Dumbreck, Glasgow, S.1, where his death took place. He was a director of Craig and Rose, Ltd., of Leith, and was a member of the Board of Governors of Paisley Technical College.

American Destroyers Arrive Safely

ON Saturday, September 28th, the first flotilla of the United States destroyers which have been handed over to the Royal Navy in exchange for the leasing of certain naval bases safely arrived in a British port after an uneventful voyage. References to these destroyers and the names allotted to them by the Government have already been made in these columns. The principal dimensions and particulars of the ships are as follows:—Length overall, 314ft.; beam, 30ft.; mean draught, 9ft. 3in.; maximum draught, 10ft.; displacement, 1190 tons; armament, four 4in. guns, one 3in. anti-aircraft gun, and twelve 21in. torpedo tubes. The propelling machinery comprises a twin-screw arrangement of Westinghouse or Parsons geared turbines taking steam from four White-Forster or Normand boilers. The horsepower is from 25,000 to 27,000, with a designed speed of about 35 knots. In all 157 of these flush-decked destroyers were laid down and completed by American Navy yards and shipbuilding yards between 1917 and 1922. On arriving in Canada from the American naval yards the ships were "degaussed" and they made an excellent Atlantic crossing in five days, steaming at an economical speed so that plenty of fuel was left. It is expected that the destroyers will now be stripped for action and that some modifications may be made to their armament. Features of design which will appeal to the officers and crews which will man them include roomy mess decks, and also such refinements as showers and refrigerators. Further design features include four funnels and an enclosed bridge with roof and glass windshield, while upholstered motor-car seats on the bridge are provided. We are given to understand that the officers and ratings are highly pleased with the destroyers, which were handed over in splendid condition, fully armed, and equipped down to such minor details as navigation instruments and binoculars. Further destroyers are expected shortly, and it has been arranged that Canada will take over six of the former United States destroyers which are now in Canadian waters. These ships will be named "Annapolis," "Columbia," "Niagara," "St. Clair," "St. Croix," and "St. Francis," after rivers which are common to Canada and America.

Generating Stations and Wartime Electricity Supply

IN virtue of his powers under the Defence Regulations, the Minister of Transport has made the Central Electricity Board (Provision of Generating Stations) Order, 1940, dating from September 16th, 1940. The Order reads as follows:—For the purpose of the supply of electricity by the Central Electricity Board (hereinafter referred to as "the Board") in fulfilment of their duties as undertakers and authorised undertakers within the meaning of the Electricity (Supply) Acts, 1882 to 1936, in the interests of the public safety, the defence of the realm, or the efficient prosecution of the war, or for maintaining supplies and services essential to the life of the community, the Board may themselves generate electricity and subject as hereinafter provided may provide and operate generating stations; and the obligations and limitations imposed on the Board by or by virtue of the Electricity (Supply) Act, 1926, with respect to the generation of electricity and the provision and operation of generating stations by the Board themselves shall be relaxed accordingly. Provided that nothing in this Order shall relieve the Board from the necessity of obtaining the consent of the Electricity Commissioners under Sec. 11 of the Electricity (Supply) Act, 1919, to the establishment or extension of any generating station by the Board, and that the Board shall not themselves operate a generating station unless they satisfy the Electricity Commissioners that they are unable to enter into an arrangement with the authorised undertakers in whose area of supply the station is situated to operate it on reasonable terms. Sub-section (2) of Sec. 4 of the Electricity (Supply) Act, 1926, which requires the Board to give public notice of not less than one month of the date by which persons interested may make representations on the scheme referred to in the said subsection shall be modified by the substitution of the period of ten days for the period of one month above referred to.

British Naval Successes and Losses

DURING the past week the Admiralty announced the loss of H.M. submarine "Thames," H.M. sloop "Dundee," and H.M. trawler "Loch Inver." Against these losses may be put the success which has attended the efforts of our submarines to search out and attack enemy shipping. It has been disclosed that H.M. submarine "H49" recently attacked a convoy of eight supply ships with torpedoes, two of which found their mark. H.M. submarine "Tuna" has reported the destruction of a large supply vessel screened by two enemy destroyers. Some time ago it was reported from Stockholm that a German transport had been sunk by a British submarine off the Skaw on the evening of September 2nd, and that a very large number of German troops had been killed. This report was denied by the German wireless and official news agency, but it would now appear to be fully substantiated by a report received from H.M. submarine "Sturgeon," which successfully attacked on the evening of the date mentioned a heavily laden enemy transport off the northern point of Denmark. The enemy ship was believed to be of about 10,000 tons and was escorted by small naval vessels and aircraft. The attack was made in difficult conditions of light and heavy weather. Torpedoes hit the enemy transport, from which were seen to arise brilliant flashes of flame and a dense column of black smoke. A few minutes later the whole ship burst into flame. When the submarine came to the surface some time later the transport had sunk and her escorting vessels were sweeping the water with searchlights looking for survivors. Of the vessels mentioned above, the "Thames" was one of a class of three ocean-going submarines and was completed in 1935. She was the first diesel-driven submarine to exceed a speed of 21 knots, her trial speed being 22·5 knots. The submarine "Sturgeon" is of the smaller "Swordfish" class and has a speed of under 14 knots. The "Dundee" was an escort vessel of 1060 tons displacement, which was built at Chatham in 1932.

Central Electricity Board War Emergency Stations

THE Central Electricity Board has received from the Electricity Commissioners two schemes which amend respectively the existing electricity schemes for South-East England and South-West England and South Wales by providing for an additional selected station to be erected in each of these areas. It is specified in the schemes that the new station contemplated in the South-East England area shall comprise an installation not exceeding 50,000 kW of three-phase, 50-cycle generating plant, and that the other in the South-West England and South Wales area shall not exceed 30,000 kW capacity. It is further stated that the size and positions of each station will be finally determined by war emergency requirements and not by considerations which may arise from the normal growth of load on the grid system. The schemes have been prepared by the Electricity Commissioners, in pursuance of Sec. 4 of the Electricity (Supply) Act of 1926.

The British Association of Used Machine Tool Merchants

AT a meeting which was recently held at the Queen's Hotel, Birmingham, of members of the used machine tool trade of Great Britain, it was decided to form an association, under the title of the British Association of Used Machine Tool Merchants. The following officers were elected:—President, Mr. Frank Widdowson, of Herbert Widdowson and Sons, Ltd., Nottingham; Vice-President, Mr. J. L. Litton, of Litton's Machine Tool Company, London; Chairman, Mr. J. E. Raistrick, of J. S. Raistrick, Ltd., London; Vice-Chairman, Mr. R. J. Austin, of Centaur Tool Works, Birmingham; Treasurer, Mr. J. L. Litton. The Secretary is Mr. R. F. Ward, and the temporary offices of the Association are at 6, Park Royal Road, North Acton, London, N.W.10. The following members were elected to serve on the Committee of the Association:—Mr. H. Ford, of Byford's, Ltd., West Bromwich; Mr. Mather, of Lee and Hunt, Ltd., Nottingham; Mr. G. S. Wear, of John Cashmore, Ltd., Great Bridge; Mr. H. Vernon, of Thos. W. Ward, Ltd., Sheffield; Mr. H. Weston, of Modern Machine Tools, Ltd., Coventry; Mr. G. Hemingway, of Alfred Herbert, Ltd., Coventry; Mr. C. H. Payne, of W. Forrest and Co., Ltd., Sheffield; and Mr. F. G. Calverley, of Martin Bros. (Machinery), Ltd., Manchester. In his address Mr. Raistrick welcomed such a representative gathering.

A Fuel Oil Burner Export Group

IT is officially announced by the Board of Trade that member firms of the British Oil Burner Manufacturers' Association, who specialise in the manufacture and application of oil-burning equipment, have formed the Fuel Oil Burner Export Group, under the export scheme fostered by the Board. The chairman of the Group is Mr. W. A. Hubbard, of Combustions, Ltd., and Messrs. C. Meilke, of May Oil Burner (England), Ltd.; J. S. Greenhalgh, of Babcock and Wilcox, Ltd.; and C. Roman, of Nu-Way Heating Plants, Ltd., form the Executive Committee of the Group. The Secretary of the Group is Mr. Stanley Henderson, and the offices of the Group are at 69, Cannon Street, E.C.4; telephone number, City 4444. The following engineering firms are members of the Group:—Amal, Ltd., Babcock and Wilcox, Ltd., S. Batchelor and Son, Ltd., Combustions, Ltd., Laidlaw, Drew and Co., Ltd., May Oil Burner (England), Ltd., Nu-Way Heating Plants, Ltd., G. C. Pillinger and Co., Ltd., Rheostatic Company, Ltd., Universal Oil Burners, Ltd., Urquhart's (1926), Ltd., Wallsend Slipway and Engineering Company, Ltd., and J. Samuel White and Co., Ltd. One of the objects of the newly formed Export Group is to develop the overseas markets from which Germany and the countries occupied by German forces are cut off. Arrangements have been made to give special attention to the trade requirements of markets in the British Dominions, Palestine, Egypt, Irak, Iran, Portugal, the Dutch East Indies and the Far East.

Two Hydraulic Models

THE Portuguese Ministry of Public Works recently entrusted to the Neyret-Beylier and Piccard-Pictet hydraulic laboratory at Grenoble the investigation of two separate projects of hydraulic construction in Portugal envisaged by the Department of Irrigation.

A very full report of the model experiments carried out at the Grenoble laboratory is contained in a volume recently issued by the Irrigation Department of the Ministry.

The schemes which were investigated were :—(*a*) A flood spillway in connection with the Idanha dam in the valley of the River Ponsul, a tributary of the Tagus ; and (*b*) a flood spillway at the Pego do Altar dam on the Santa Catarina River in Southern Portugal. Both works are now in course of construction.

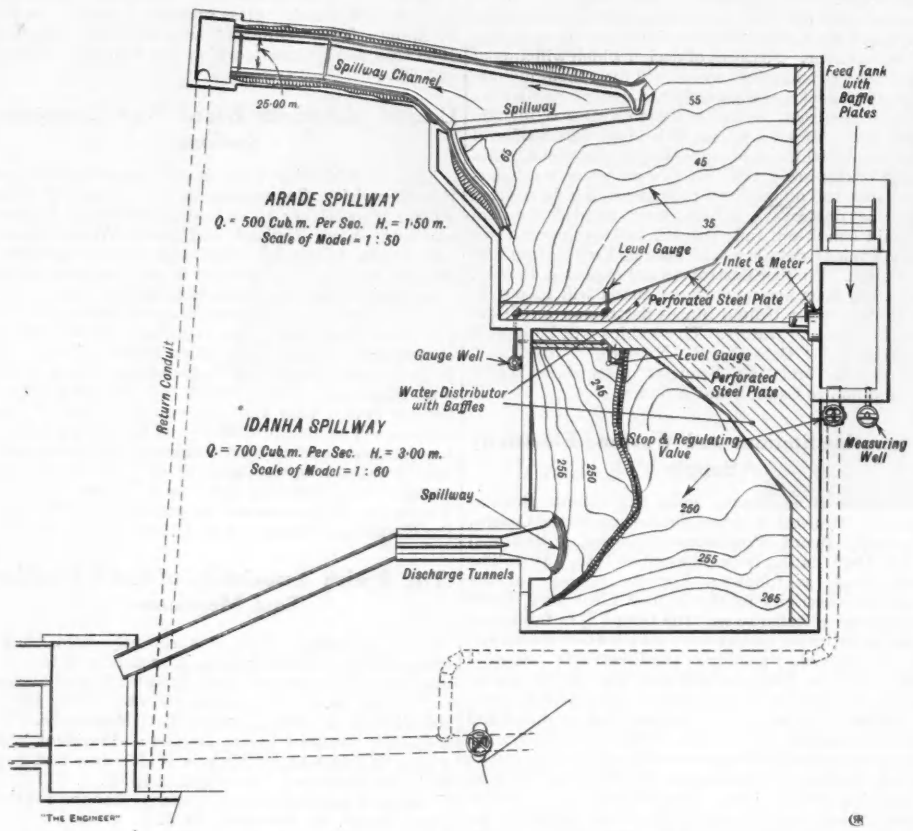


FIG. 1—PLAN OF 1/60 MODEL OF IDANHA SPILLWAY

The schemes which were investigated were :—(*a*) A flood spillway in connection with the Idanha dam in the valley of the River Ponsul, a tributary of the Tagus ; and (*b*) a flood spillway at the Pego do Altar dam on the Santa Catarina River in each about 600 m. long, driven in granite rock, with their downstream outlets situated in a small ravine on the left bank of the river, about 400 m. below the downstream face of the dam. The flow in the tunnels will be free and not under a head of pressure. At the site selected for the construction of the spillway the slope of the ground is relatively flat, and the depths of water over the ground in the neighbourhood of the spillway and upstream of it under flood conditions are relatively small. The original design for the spillway, prepared by the Irrigation Department, comprised a masonry overflow cill, circular in plan, its crest being at a level +255·5 m., and having a length of 80 m. The maximum water level in the reservoir under flood conditions was assumed to be +258·5 m. The water passing the crest at times of flood flows to the tunnel openings over a paved apron roughly triangular in shape, the angle between the splayed walls at the sides of the apron being 90 deg.

The problem to be studied by means of model experiments was the form of the spillway apron and tunnel inlets which would give the optimum discharge under flood conditions. Two model sets were employed in making tests. One set was constructed to the scale of 1/100, the other having a scale of 1/60. The small-scale model was used for preliminary tests, the models made on the larger scale being employed for the more detailed experiments. The 1/60 model (vertical and horizontal scales, 1 : 60) used in the later series of experiments reproduced accurately the contours of the site in the neighbourhood of the spillway. A plan of this model is shown in Fig. 1. The separate model shown in the upper part of this figure had no connection with the Idanha experiments. It had been constructed in the laboratory and placed alongside the Idanha model for reasons of convenience of water supply and repumping.

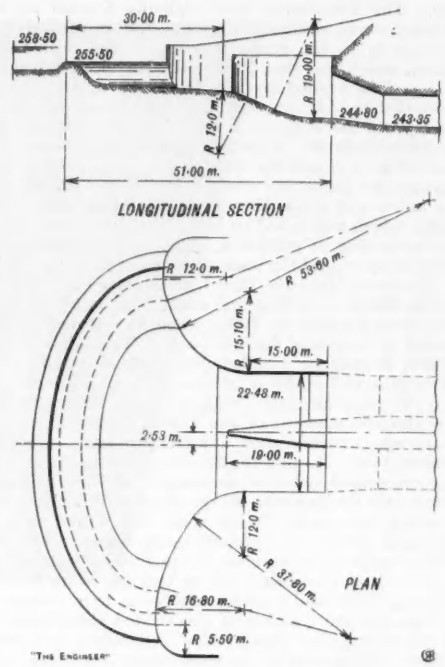


FIG. 3—DETAIL OF 1/60 MODEL

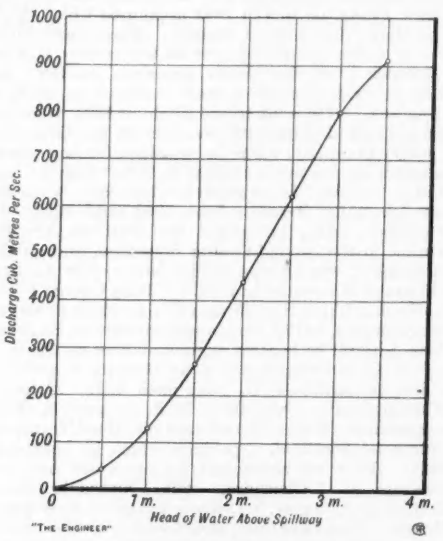


FIG. 4—DISCHARGE CAPACITY OF SPILLWAY AND TUNNELS

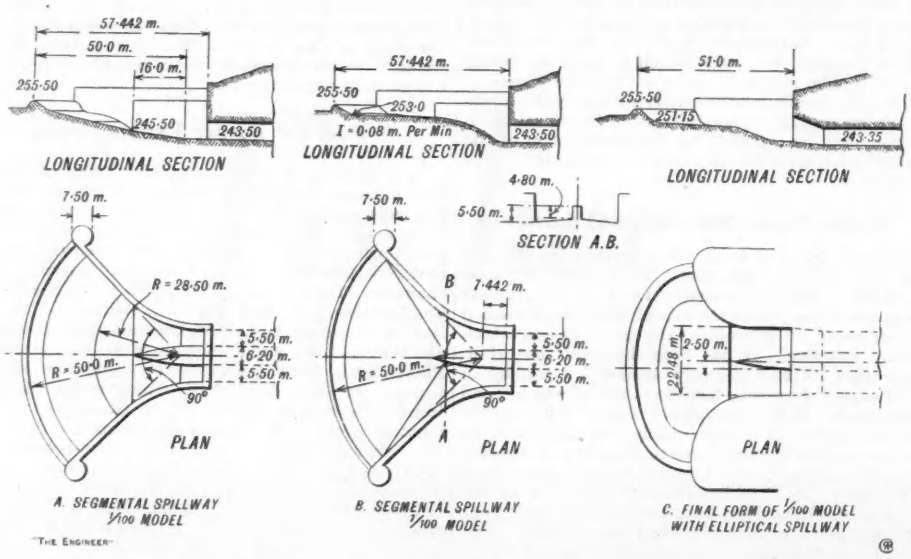


FIG. 2—SOME FORMS OF EXPERIMENTAL APRON PROFILES AND TUNNEL CUTWATERS

The Idanha Dam

The dam is situated in the valley of the River Ponsul, and will, when it is completed, retain nearly 78,000,000 cubic metres of water for the

The scale factor of area in the 1/60 model is $60^2=3600$, and the volume factor $60^3=216,000$. The factor for velocity is $\sqrt{60}=7\cdot75$ and for discharge $60^{5/2}$. The discharge head upstream of the crest of the model under conditions of maximum flow, 700 cubic metres per second, is about 5 cm. The two discharge tunnels were reproduced to scale in the model for a length of 120 m. In the earlier tests the plan of the spillway crest was circular in form, in accordance with the design for the work prepared by the Department of Irriga-

tion. The supply of water to the model was from a tank through a Venturi meter. The tank was also fitted with a baffling arrangement to reduce the turbulence to a minimum. In the model itself a perforated steel plate set along the upper margin of the contoured ground surface secured an even flow of water to all parts of the model surface. The level of the water on the collecting surface above the spillway cill corresponding to a particular discharge value was measured in a small well in the model by an instrument reading to 1/20 mm. The first trials carried out with the circular spillway in the 1/100 model, made while the definitive model was in course of preparation, showed clearly that the hydraulic efficiency of the work could be materially improved by making use of the principle of conjugate cills which had been studied in some detail in models of a storm overflow intended to be constructed at Bissorte in Savoy. The conjugate cill principle introduces a second and much less definite cill in the apron below the main overflow cill. This has the effect of redistributing the liquid filaments which are reassembled in one or more water sheets. The disturbance at the tunnel entrances is thereby reduced to a minimum, and at the same time the discharge to the tunnels is increased.

One special difficulty which had to be met in the course of the Idanha tests was the disturbance of the liquid filaments due to the rapid convergence of the side walls of the apron and the diversion of the flow into two parts at the entrance to the twin tunnels. The convergence results in pronounced surges. Several forms of apron profile and tunnel cutwater were tested in the smaller model. Outline plans and sections of a few of these are reproduced in Fig. 2. The most successful of these tentative tests, Fig. 2 *c*, was adopted as the basis of the definitive model on a scale of 1/60.

The preliminary tests indicated that a spillway crest circular in plan produced a dissimilarity of flow of water on the two sides of the cutwater pier at the entry to the tunnels. The 1/60 model was therefore constructed in the form shown in Fig. 3 and in the photograph reproduced in Fig. 5. The successive modifications of the model and the improvements introduced in it showed that the intended discharge of 700 cubic metres per second was, in fact, reached when the head was no more than about 2·7 m., instead of 3·0 m., as designed, and that small modifications made to reduce surges in the tunnels raised their discharge capacity under a head of 3 m. to 800 cubic metres per second (Fig. 4). The final form of the model is shown in Fig. 6. Photographic views of the models are also reproduced in Figs. 7 and 8. As a result of the experiments the low-lying parts of the gathering area above the spillway were filled in the model to level +254 m. (1·5 m. below crest level), and this modification has been provided for in the work of construction since carried out on the site of the spillway.

FIG. 5—IDANHA SPILLWAY MODEL IN ORIGINAL FORM

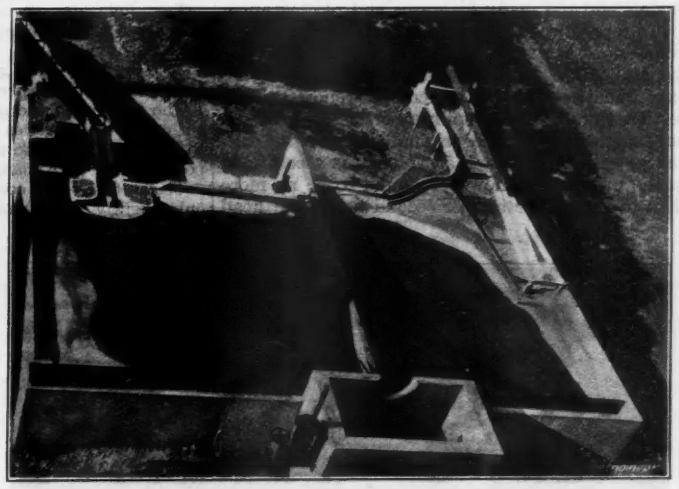


FIG. 7—VIEW OF IDANHA AND ARADE MODELS

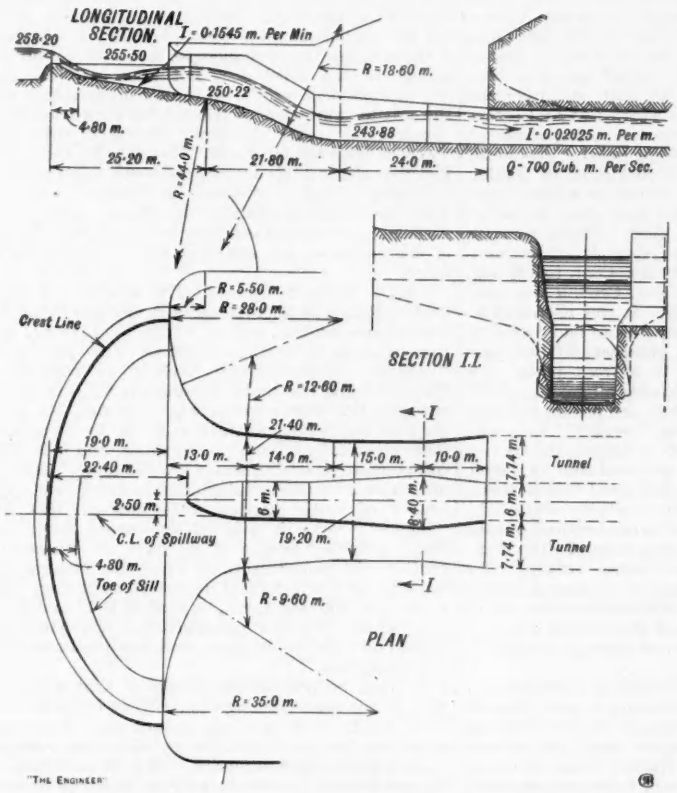


FIG. 6—FINAL FORM OF IDANHA SPILLWAY MODEL

THE PEGO DO ALTAR MODEL

The flood spillway constructed in conjunction with the Pego do Altar dam on the River Santa Catarina, in Southern Portugal, is intended to provide for a discharge of 1000 cubic metres per second, which would be attained when the level in the reservoir is raised above the normal top-water level to a height of 1·5 m. Several alternative schemes for the discharge of flood water were considered before that finally adopted was approved. One design comprising a spillway having a crest length of 250 m. was rejected, owing to the irregularity of the site contours and the difficulty of finding a suitable position where a work 250 m. long could be constructed at moderate cost. Another solution provided for the flood discharge through openings closed normally by automatic flood gates. This plan would have permitted the gate cills to be placed at a much lower level than that of the spillway crest, and the flood water passing through the gate openings would have been discharged through an open channel to the tunnel below. The plan finally adopted is a combination of these two systems, comprising a spillway of limited length in the middle of which is an open channel with its cill at a lower level than that of the spillway crest, the channel being normally closed by a gate. Below the spillway the flood waters discharge to a tunnel.

The model experiments carried out in the Grenoble laboratory had as their object to determine the best form to be given to the spillway crest and the shape of the apron below the crest best adapted to the discharge of the water to the tunnel entrance. A preliminary study of the crest profile was made on a model of 1/10 scale, representing a typical portion of the crest, while the problem as a whole was investigated by trials with a model of the complete work made to a scale of 1/60.

The 1/60 model embodied an accurately contoured representation of the country immediately above the spillway, over which water would flow under flood conditions in a shallow sheet. This model

FIG. 8—FLOW OVER SPILLWAY

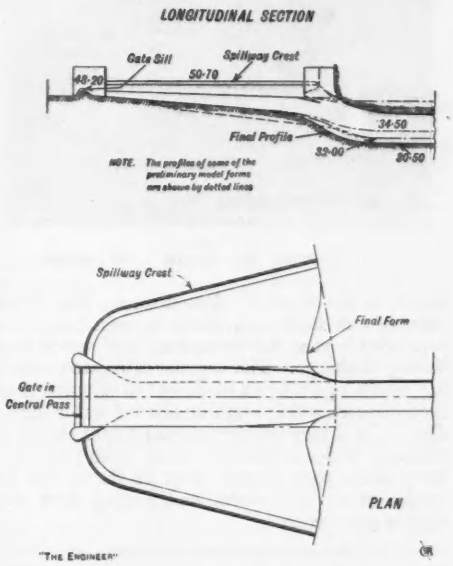


FIG. 9—PEGO DO ALTAR MODEL

also reproduced the intended structural works, including the spillway apron, the deep channel, and the discharge tunnel prepared in accordance with the design of the Irrigation Department. While the larger model was being prepared, preliminary tests were made—as was done in the case of the Idanha model—on a 1/100 scale model. The details of the series of tests made with the several models and the many diagrams and photographic views reproduced in the laboratory report are too voluminous for summarising in the space at our disposal. The final results obtained from the experiments may be stated as follows:—The sectional profile of the spillway crest was modified only slightly from the original design; the discharge over the crest, 175 m. long, as ascertained in the model, was, however, found to be no more than 680 cubic metres per second under the head of 1·5 m., instead of 730 cubic metres per second, the value calculated from the original design. On the other hand, modifications made in the model affecting the form of the apron, the section of the deep channel-way, and the tunnel entrance, increased the discharge through the central gate pass and to the tunnel from the designed value of 260 to 370 cubic metres per second. This improvement was due in the main to modifications in the vertical curvature of the apron section. The total discharge capacity of the spillway and gate pass is therefore 1050 cubic metres per second.

A sketch plan showing the model in its final form is reproduced in Fig. 9. The outlines of the original model based on the theoretical design are shown in the figure by dotted lines. Fig. 10 is a view of the model, in which is seen the stereopantograph used for measuring the water levels during discharge. The vertical calibrated measuring needle operates an electrical circuit and sound recorder on making contact with the water surface. Fig. 11 is a view of the original 1/100 model discharging under a head of 1·0 m., with the gate in the central pass closed. Fig. 12 shows the 1/60 model in its final form discharging 1000 cubic metres per second.

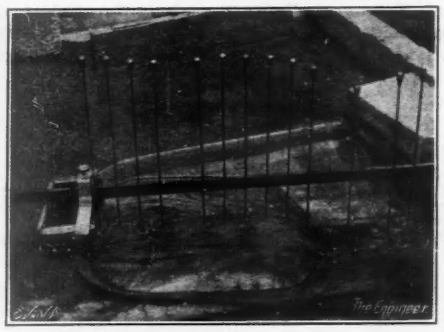


FIG. 11—PEGO DO ALTAR 1/100 MODEL

FIG. 10—STEREOPANTOGRAPH FOR USE WITH PEGO DO ALTAR MODEL

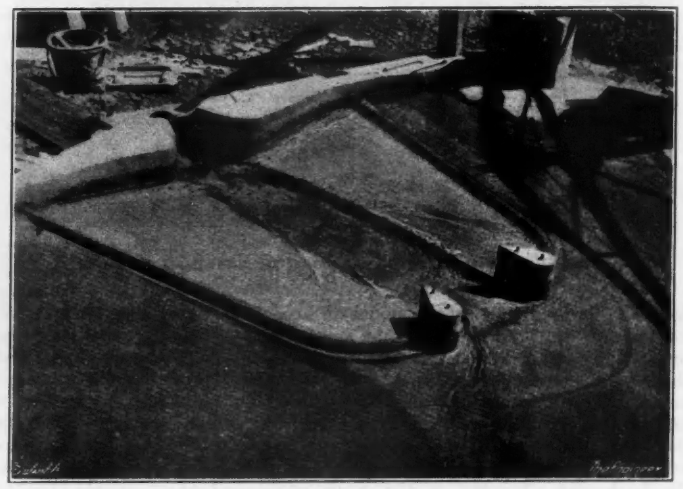


FIG. 12—FINAL FORM OF PEGO DO ALTAR 1/60 MODEL

AMMONIA PLANT FOR CANADA.—At Calgary, Alberta, a plant is to be installed for the manufacture of ammonia used in the production of explosives. It will be constructed 3 miles south of the city, near Turner Siding, at a capital expenditure of the sum of 20,000,000 dollars. The plant will be operated by the Consolidated Mining and Smelting Company, while the initial immediate outlay for construction of the plant will be made by the British Government. It will have a capacity of 100 tons daily and is expected to begin production within a year.

The Static Friction of Lubricated Surfaces*

By A. FOGG, M.Sc., and S. A. HUNWICKS, B.Sc. (Eng.)

(*Continued from page 207, September 27th*)

RESULTS

FATTY OILS

THE following vegetable and animal oils were chosen as being representative of the more common fatty oils in use:—

Vegetable Oils.—Castor, rape, olive, coconut.

Animal Oils.—Sperm, pale whale, neatsfoot, lard.

The friction of the steel surfaces when lubricated with each of these was measured at temperatures up to 100 deg. Cent., the usual cleaning operation being performed at each change over.

Castor Oil.—The coefficient of friction (μ) varied only slightly with temperature, showing a tendency to rise as the temperature increased. At 20 deg. Cent. $\mu = 0{\cdot}09_5$ and at 100 deg. Cent. $\mu = 0{\cdot}10_5$. There was no appreciable difference with the temperature rising or falling, and thus no permanent change in the friction as a result of heating in air to 100 deg. Cent.

Coconut Oil.—The coconut oil was a white, greasy solid at air temperature. A small quantity was melted and poured into the oil bath and over the friction surfaces. The oil was allowed to cool before making observations, the first test being made at 20 deg. Cent., the oil then being solid. The mean value of four observations of coefficient of friction was 0·18, the carriage being moved to a fresh place each time. The temperature was then raised to 100 deg. Cent. and the oil then allowed to cool, observations being made at intervals of approximately 20 deg. Cent. From 40 deg. Cent. to 100 deg. Cent. and down again to 40 deg. Cent. μ was very constant, its value being 0·08. It was necessary to wait overnight before the temperature had cooled to 20 deg. Cent., and the first observation then gave $\mu = 0{\cdot}26$. Without moving to a fresh place, four observations immediately following all gave $\mu = 0{\cdot}08$. The high values at 20 deg. Cent. are presumably due to the balls and ring becoming "welded" with solid fat; once this "weld" has been broken the friction is low and independent of the physical state of the oil. The boundary lubricating properties of this oil therefore appear to be the best of the vegetable oils tested.

Neatsfoot Oil.—There was a certain amount of solid separation in this oil at air temperatu e. The drum was warmed and shaken well before drawing off a sample for test. Although there was some separation from the test sample at air temperature, the results were not affected by this, and the friction was constant throughout the temperature cycle, the value of μ being $0{\cdot}09_5$.

This group of oils may be taken as representative of all fatty oils, and it is interesting to note that the variation of friction, due to changes of oils within the group or to temperature, is quite small, the extreme values of the coefficient of friction being 0·08 and $0{\cdot}10_5$. A satisfactory feature of these measurements is that repetition was extremely good, and although mean values have been given, the departure of any one observation from the mean was small (about $\pm 0{\cdot}01$), being less than is usually encountered in friction measurements in any state except that of complete fluid film lubrication. These two features, constant friction and consistency, are to be expected, since fatty oils are to a large extent composed of chemical compounds of similar constitution; the surfaces thus become covered with a layer which is, broadly speaking, homogeneous, and whatever relative position is taken up by the opposing surfaces the separating layer is always the same.

STRAIGHT MINERAL OILS

Oil A. Light Machine Oil.—There was much more variation in the results obtained under constant conditions with this oil than with any of the fatty oils, and a change in friction with temperature. The mean value of μ at 20 deg. Cent. was 0·16, and at 100 deg. Cent. 0·19, the increase being spread gradually over the whole temperature range.

Oil B. Motor-Car Engine Oil.—This sample of oil was drawn from a supply refined by the conventional or acid process. There was a gradual increase in the value of μ with temperature from 0·13 at 20 deg. Cent. to 0·15 at 100 deg. Cent., the friction falling to its original value when the oil was cooled to air temperature. Repetition of results was good at the lower temperatures, but there was a variation of about $\pm 0{\cdot}02$ in the value of μ at higher temperatures.

Oil C. Thick Gear Oil.—This oil is highly viscous, being in a "semi-solid" condition at air temperature. The friction was almost identical with that of the previous oil, the value of μ ranging from $0{\cdot}12_5$ at 20 deg. Cent. to 0·15 at 100 deg. Cent. Repetition of results again was not so good as with fatty oils. These results show that, for these three typical mineral oils, there is no definite relation between friction and viscosity. The increase in viscosity from the first to the second is accompanied by a reduction in friction, but the large increase in viscosity from the second to the third does not affect the friction. Another point of interest in these measurements was the greater variation of friction between successive observations under the same conditions than was observed with the fatty oils. This may be due to the fact that mineral oils are composed of a large number of highly complex chemical compounds, some of which are probably adsorbed on different parts of the surfaces; the friction will thus depend on the position of the contacts and whatever layer happens to be there.

Oil D. (*Solvent Refined.*)—The solvent extraction process results in improvements in viscosity-temperature characteristics and in chemical stability, but there appears to be some doubt as to its value when "oiliness" characteristics have to be considered. There is some reasonable foundation for this doubt, not so much from experimental evidence, but from the fact that solvent extraction is said to remove the more chemically unstable compounds, and it is these compounds, generally, which are the more "active" ones from a boundary lubrication point of view. The results of static friction tests indicate that the "oiliness" value is reduced by solvent extraction. This particular sample of oil gave an increase in friction with temperature as with other mineral oils, but the value of μ ranged from 0·15 at 20 deg. Cent. to 0·20 at 100 deg. Cent., as against 0·13 and 0·15, respectively, for the corresponding conventionally refined oil; the results again were less consistent than with fatty oils.

It must be pointed out, however, that a definite case is not made out against solvent extraction by these results because of the lack of exact knowledge regarding the source and history of the two samples.

A Synthetic Lubricating Oil.—This oil was produced by the Fischer process at the Fuel Research Station, but the quantity available was insufficient to fill the oil bath of the machine. The friction ring was covered, but it was impossible to make measurements except at air temperature. The friction was rather variable as with mineral oils, and the value of μ varied between 0·12 and 0·16, with a mean of 0·14. This result places the oil midway between the oils B and D, one conventionally refined, the other solvent refined. If judged by this test alone, therefore, this synthetic lubricating oil is up to the same standard of "oiliness" as normal motor oils.

Light Motor Oils.—The results obtained for this group of oils show a fairly wide variation from $\mu = 0{\cdot}12_5$ to $0{\cdot}20_5$, a scale of values sufficiently open to allow the comparative boundary lubricating properties to be fairly easily assessed.

As one of the objects of the investigation was to examine the possibilities of this apparatus as a testing

* Reprinted from the *Journal* of the Institute of Petroleum—Abstract.

machine, it is obviously desirable that some standard substances should be available as references, and should preferably give results, at each end, at least, of a scale which is large enough to embrace all substances likely to be useful as lubricants. As a step in this direction it was decided to make measurements with (1) oleic acid, for the lower end of the scale, and (2) B.P. paraffin for the upper end.

Oleic Acid.—The friction observations were very consistent and independent of temperature, the value of μ under all conditions being 0·08. This is lower than the value of μ for all other substances examined with the exception of coconut oil, which has the same value.

B.P. Paraffin.—This is not ideal for reference purposes, because it is not a single substance and its composition is unknown and may vary from time to time. The results obtained were less consistent than with any of the substances so far used. A microscopic examination of the lower friction surface after tests to 100 deg. Cent. indicated that very small pieces of metal had been torn from the surface. This phenomenon repeated itself after the surfaces had been reconditioned. There was an increase in friction with temperature, and the mean value of μ ranged from 0·18 at 20 deg. Cent. to 0·22 at 100 deg. Cent.

These results give B.P. paraffin approximately the same boundary lubricating value as the poorer mineral oils; tearing of the surfaces, however, did not occur with any other of the mineral oils, and it is therefore difficult to understand why this should be exclusive to B.P. paraffin.

Extreme Pressure Lubricants

The action of extreme pressure lubricants is not clearly understood, but it is frequently stated that their action is not due to any superior "oiliness" qualities they may possess. Their ability to prevent seizure or breakdown under surprisingly high pressures is generally attributed to a chemical action between the "active" constituents of the lubricant and the metal surfaces, but the nature of the action is still the subject of some controversy.

In view of the controversial nature of the subject it was considered desirable to measure the static boundary lubricating properties of a group of typical extreme-pressure oils in an attempt to provide additional information on the subject.

All these oils gave very consistent results, repetition being as good, if not better, than with fatty oils. Since the diluent or base oil is probably of mineral origin, and therefore a complex mixture of chemical substances, it appears that this part of the oil plays little or no part in determining the static friction, but that the whole of the surface is covered by the active constituents.

There is remarkably little variation between these oils as regards friction characteristics under static boundary conditions, and as a class they lie between fatty oils and straight mineral oils. They may be regarded, therefore, as having high boundary lubricating properties even up to 100 deg. Cent., but this cannot be the reason for their extreme pressure properties, since fatty oils, which have higher boundary lubricating properties, have considerably lower extreme-pressure properties.

Graphited Oil

Graphite, in colloidal form, is widely recommended as an additive to mineral oils for the lubrication of many mechanisms. It is fairly obvious that under fluid film conditions its presence can have no effect, except in so far as it may cause small changes in viscosity. It is, however, claimed that it forms on the metal surface a new surface known as a "graphoid" layer, and that this layer not only reduces the possibility of seizure should lubrication fail, but that it also causes a reduction in friction. This can only mean a reduction in friction under boundary conditions. Tests on the static friction machine would appear, therefore, to be a suitable means of verifying this.

Accordingly, the surfaces were cleaned and covered with oil D (solvent refined) containing colloidal, graphite. Friction measurements were begun immediately, and the first determination at 20 deg. Cent. gave the same value of μ as for the untreated oil—namely, 0·15. As the temperature was raised μ increased to 0·18 at 60 deg. Cent., still behaving as the untreated oil. With further increase of temperature the friction began to fall, the value of μ at 100 deg. Cent. being 0·16. The oil was then allowed to cool, and the friction gradually fell, the value of μ at 20 deg. Cent. being $0{\cdot}12_5$, showing a substantial reduction on the value at the start of the temperature cycle. The machine was left untouched overnight, and next day friction measurements were made over the same temperature cycle. At 20 deg. Cent. the value of μ was $0{\cdot}12_5$, rising to $0{\cdot}14_5$ at 100 deg. Cent., and falling again to $0{\cdot}12_5$ at 20 deg. Cent. A repeat of the whole of these measurements gave the same results.

It appears, therefore, that an appreciable reduction in friction is obtained by the addition of colloidal graphite to this mineral oil, the values of μ for the treated and untreated oil being, respectively, $0{\cdot}12_5$ to $0{\cdot}14_5$ and 0·15 to 0·20 over the temperature range 20 deg. Cent. to 100 deg. Cent. [The improvement obtained is approximately equal to the difference between the results for oil B (conventionally refined) and oil D (solvent refined).]

These results also show that the improvement is not immediate, and that an interval of time (or possibly an increase in temperature) is necessary for the changed conditions to be established.

In order to determine whether the graphited oil had any effect on the surfaces which would persist after removal of the oil, the surfaces were flushed well with benzene to remove all surplus oil.

Measurement of the friction then gave a value of μ of $0{\cdot}12_5$ at 20 deg. Cent.—*i.e.*, removal of the surplus oil did not affect the friction, indicating that graphite in some form had been left behind on the surfaces.

The surfaces were then covered again with untreated oil, the value of μ being $0{\cdot}12_5$ at 20 deg. Cent., which shows that after using graphited oil the friction of the surfaces remains at the low value obtained with the graphited oil when untreated oil is used afterwards.

No attempt was made to determine the duration of this effect.

Compounded Oil

Rape oil, in various proportions, is commonly used for compounding with mineral oils in order to improve the "oiliness" qualities of the latter. Generally, comparatively small proportions, of the order of 5 per cent., of rape oil are added, and it is generally thought that little, if any, further improvement would be obtained by exceeding this amount. In order to check this belief and the general effect of compounding, observations were made on mixtures of varying proportions of rape oil and the solvent-refined mineral oil, oil D. The latter was chosen as being representative of the "inactive" or "non-polar" substances, and one, therefore, which would be expected to show the greatest improvement by compounding.

Mixtures containing 2, 5, 20 and 50 per cent. (by weight) of rape oil were made up, and friction measurements obtained up to 100 deg. Cent. The results are shown in Fig. 1, coefficient of friction being plotted against percentage of rape oil in the mixture. It will be seen that the friction falls fairly rapidly, at all temperatures, with comparatively small additions of rape oil, but the friction at 100 per cent. (rape oil only) is less than for any mixture, the fall in friction being gradual from pure mineral oil to pure rape oil. For practical purposes, however, there appears to be little advantage in increasing beyond 20 per cent. rape oil, approximately three-quarters of the total possible gain being obtained at this mixture strength.

Experiments with another series of mixtures gave similar results. These were mixtures of oleic acid and B.P. paraffin, with amounts of the former of 1, 2, 5, 10, 20 and 50 per cent. (by weight). As mentioned earlier these two substances are at the extremes of the "scale of oiliness" of the usual lubricating oils, and are therefore particularly suitable for observing the effects of compounding.

The results are shown in Fig. 2, coefficient of friction being plotted against percentage of oleic acid. This curve is similar to the one obtained for rape oil and mineral oil mixtures, the friction falling gradually from pure B.P. paraffin to pure oleic acid, the value of the friction for the latter being lower than for any mixture. The rate of fall of friction at small percentages of the "active" substance, however, was greater than in the previous case.

These results show, therefore, that a considerable gain in the boundary lubricating properties of a mineral oil is obtained by compounding with a fatty oil or a fatty acid, but that in neither case does the friction reach its lowest value before the percentage of the active constituent reaches 100 per cent., which is contrary to general supposition.

The static boundary lubricating properties at 20 deg. Cent. of all the substances used in this investigation are summarised in Fig. 3, where they are tabulated in the form of a scale. The coefficient of friction of clean steel on steel is shown as corresponding to minimum "oiliness," *i.e.*, the highest possible friction, whilst maximum "oiliness," as revealed by this investigation, corresponds with the coefficient of friction of oleic acid.

It appears from this diagram that a suitable scale of "oiliness" for those substances generally considered to be lubricants would have as its extremities coefficients of friction of 0·20 and 0·08.

With this machine the range from 0·20 to 0·08 is a sufficiently open scale to allow the relative "oiliness" values of lubricants to be assessed with a reasonable degree of accuracy.

Conclusion

The existence of a property of liquid films unconnected with viscosity which has a considerable influence on the friction of surfaces has been confirmed by these experiments. It is not a property of the liquid in bulk, but only of the boundary layer, as existing, for instance, between two highly loaded surfaces relatively at rest, and probably in certain types of motion. The name which has been used to describe a somewhat elusive property of lubricants for many years, viz., "oiliness," appears to be suitable for describing this property of the boundary layer.

The machine used and the technique of operation

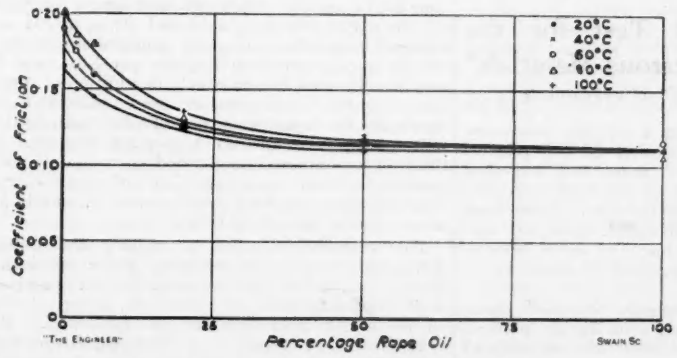


FIG. 1—*Effect of Additions of Rape Oil to Mineral Oil*

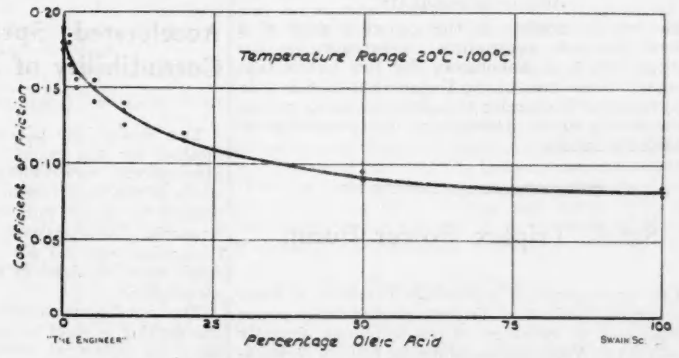


FIG. 2—*Effect of Additions of Oleic Acid to B.P. Paraffin*

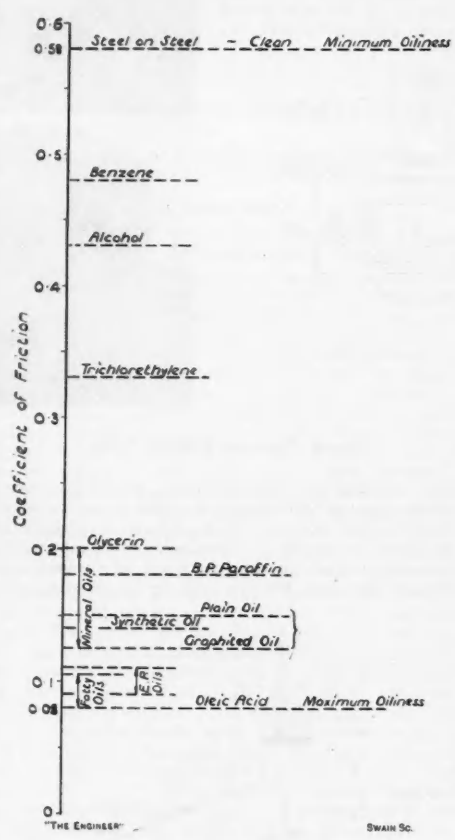


FIG. 3—*Scale of Oiliness at 20° C. (Steel Surfaces)*

applied in this investigation have given results which are sufficiently consistent to distinguish easily between the "oiliness" of different classes of oils, *e.g.*, mineral and fatty, and of oils in each class. It is suggested, therefore, that the machine should be used to supplement existing tests for lubricating oils, since this property which it measures is of vital importance in practice.

This investigation has dealt only with surfaces of one kind, hard steel, and, since it is probable that the properties of the boundary layer are dependent on the material with which it is in contact as well as on the molecular structure of the lubricant, the work is being extended to include other combinations of metals.

ACKNOWLEDGEMENTS

The work described in this report is part of a general research programme undertaken at the National Physical Laboratory for the Lubrication Research Committee of the Department of Scientific and Industrial Research; the authors wish to express their thanks to the Department for permission to publish the results.

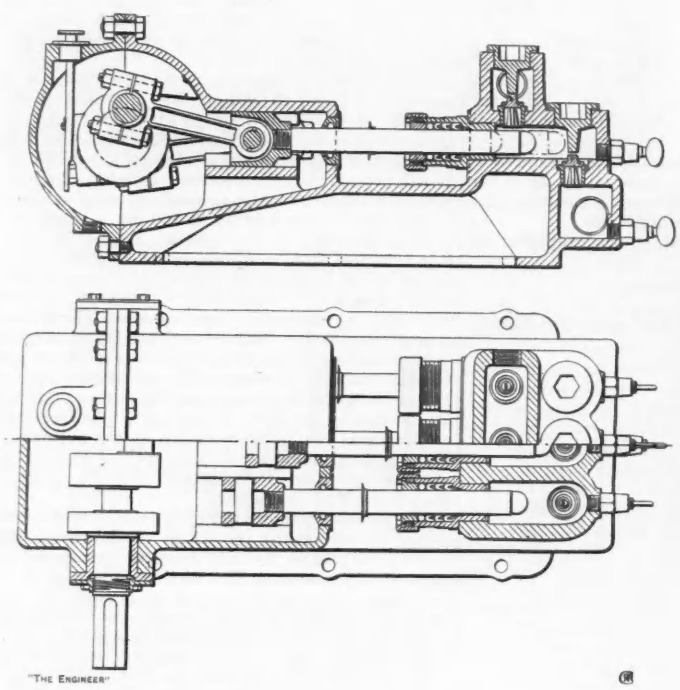
Small Triplex Power Pump

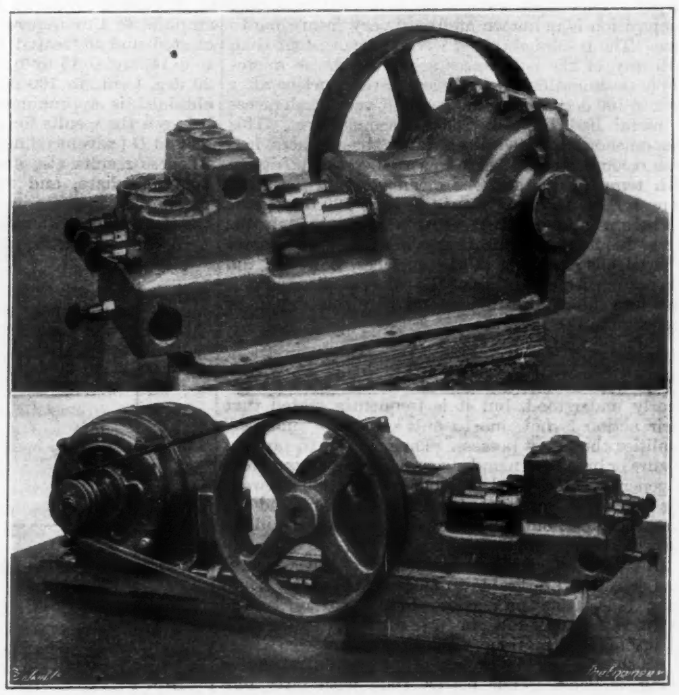
THE accompanying engravings illustrate a small 2in. stroke horizontal triplex single-acting power pump, one of a range of such pumps recently developed by Worthington-Simpson, Ltd., of Newark-on-Trent. These machines are suitable for any service where a small quantity of water at high pressure is required. They are claimed to be ideal for producing a high-velocity jet for washing purposes, and they are also suitable for use as feed pumps for small boilers.

We need not refer in great detail to the specification. The design has been influenced by the decision to manufacture in lots of 100 each in order to reduce production costs. The crank case, of grey cast iron cast integrally with the crosshead guides, bearing supports and pump body is totally enclosed, self-oiling and dustproof. It holds a particularly liberal supply of oil for the splash lubrication system. The crosshead guides and the screened portion in the pump body to receive the bronze pump stuffing-boxes are machined at one setting without removal from the jig. The crankshaft bearings are white metal die castings. The whole of the driving parts in the crank case can be easily and quickly withdrawn in one assembly for inspection or replacements by removing the crank case cover and unbolting the main bearings. Marine type connecting-rods are used and bronze crossheads. The plungers are made of Immadium bronze and are ground accurately to size in one operation with the crossheads. They are fitted with deflectors midway between the power end and the pump end in order to prevent water or oil creeping along the plungers. Oil leak preventers are fitted where the plungers pass through the crank case. Wing-guided bronze valves working in bronze seats and controlled by bronze springs are installed. The valves are accessible from above by removing the valve box covers.

The pumps are driven by belt, vee belt, or chain, and in the case of a motor-driven arrangement the motor is mounted on slide rails as shown in one of the engravings.

The maximum working pressure for which the pumps are designed is 350 lb. per square inch at a maximum speed of 300 r.p.m. Three plunger sizes can be fitted, $\frac{1}{2}$in., $\frac{5}{8}$in., and $\frac{3}{16}$in., respectively. The stroke is 2in. whatever the plunger diameter. Deliveries up to 65 gallons per hour are obtainable with $\frac{1}{2}$in. plungers, and a $\frac{1}{3}$ B.H.P. motor is required. With $\frac{5}{8}$in. plungers a delivery of 105 gallons per hour will be yielded with a driving motor of $\frac{3}{4}$ B.H.P. The $\frac{3}{16}$in. plunger pump provides up to 180 gallons per hour and requires a 1 H.P. motor for the maximum duty.





SMALL TRIPLEX POWER PUMP

Accelerated Spray Test for the Corrodibility of Ferrous Materials*

By T. SWINDEN, D.Met., and W. W. STEVENSON, A.I.C.

THE desirability of having a reliable laboratory method for the rapid evaluation of the relative atmospheric corrodibility of irons and low-alloy steels of the constructional type has long been considered by many workers in the field of corrosion research. It is generally accepted, however, that immersion tests do not produce the same order of merit as is obtained in long-period exposure to the atmosphere.

The conditions of atmospheric corrosion entail the wetting of steel by weakly acid liquids (particularly in industrial atmospheres) and subsequent evaporation of the liquids; condensation of liquids and evaporation, with changes of temperature; partial removal by mechanical means of the corrosion product, and so on. The obvious experimental procedure is suggested, therefore, of attempting to reproduce in the laboratory a cycle of atmospheric changes involving wetting and drying, heating and cooling, in which the corrosion is of the oxygen-absorption type. From the wide differences in results obtained by atmospheric exposure and by immersion in acid, the authors consider that hydrogen evolution plays no major part in atmospheric corrosion. Since the supply of oxygen will be facilitated if the corrosive medium is in the form of fine droplets, it is desirable to wet the specimens with a fine spray. Also, as the size of the droplets decreases, it should be possible to increase the acidity of the solution without unduly introducing the effect of hydrogen evolution.

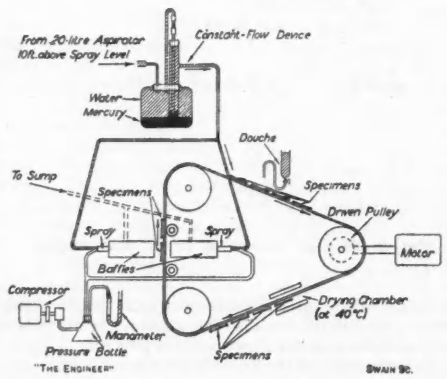


Diagram of the New Spray Apparatus

Earlier work on spray tests had been carried out by Evans and Britton, Hatfield and Shirley, Hudson and Schroeder. Schroeder's work is of especial interest, as he rendered the spraying automatic, by mounting the specimens on a belt, driven by motor and reduction gearing, thereby bringing the specimens at fixed intervals into the operation zone of the sprays. Schroeder used sprays consisting of (*a*) N/100 sulphuric acid and (*b*) a mixed salt solution containing 16 g. of ammonium sulphate and 4 g. of ammonium chloride per litre, and he also describes one test in which, in addition to spraying, downpour and sunshine were simulated, by douching the specimens periodically with water, followed by exposure to a heating element. In this test he obtained accelerated corrosion, as compared with tests when spraying only was carried out, and also a marked improvement in correlation with the short-period field test.

The authors proceeded to modify and extend Schroeder's apparatus, so that larger specimens, 4in. by 2in., could be accommodated. All operations were standardised as far as possible, in an effort to ensure equal treatment for all specimens. The principles observed were those of Schroeder's douching test in that the cycle of operations consisted of intermittent spraying, followed by exposure to a heating chamber; also, the specimens were given a daily douching with water, under standardised conditions, for the purpose of detaching loose rust from the surface.

THE TEST MATERIALS

For the spray tests a series of fourteen Corrosion Committee materials was selected, eleven of which had been the subject of previous field tests (and, in the case of seven materials, previous spray tests) and three of which were new materials—Aston-Byers iron, Swedish iron, and carbonyl iron. In all the spray tests and field tests, the results of which are given in this paper, specimens approximately 4in. by 2in. by $\frac{1}{8}$in. (weighing approximately 125 g.) were used, with their surface ground on a linisher belt, grade 80.

THE APPARATUS AND METHOD

The equipment used for the spray tests has undergone a slow process of evolution in the laboratory, and it is therefore desirable to give detailed descriptions both of the original form and of the latest form now in use. In the original apparatus the specimens (maximum number twenty, of size 4in. by 2in.) are attached to a travelling belt by means of short lengths of cord passing through holes in the specimens and hanging from hooks on the belt. The latter moves round three 12in. diameter pulleys, one of which has a belt drive from a motor and reduction gearing. The belt on which the specimens are hung moves round the three pulleys at a speed of one complete revolution per 7 min., and during each revolution

* Communication to the Iron and Steel Institute from the Central Research Department, the United Steel Companies, Ltd., Stocksbridge—Abstract.

the specimens are subjected to the following treatments :—

Spraying.—Passing between spray shields they are sprayed on both sides with the spray solution. This spray is obtained by means of compressed air (from a blower) passing from a gas reservoir to two solution reservoirs. The latter are capable of delivering a uniform spray at a distance of 12in. from the nozzle. The compressed air pressure is measured by a manometer, and is gradually increased as the level of the solution in the spray reservoirs falls. Spray is allowed to impinge on the specimens over only ½in. of their length at a given moment (*i.e.*, the specimens are sprayed for a period of about 2 sec.). Liquid not impinging on a specimen falls into a sump.

Drying.—After spraying the specimens pass round two of the pulleys, during which time they are air dried to some extent, after which they pass through a heated chamber. This is a metal box, ventilated at the top and bottom and heated by means of two carbon filament lamps working at a voltage which will raise the temperature of the air passing through the chamber to 40 deg. Cent. In passing through this chamber, during a period of about ¾ min., the specimens become quite dry on the surface, but are not heated unduly. After passing through the heating chamber, the specimens travel round the third pulley back to the sprays, and so on.

Douching.—The specimens pass through the cycle of treatments sixty times per day, five days per week for four weeks. On the second and subsequent days they are douched with distilled water and allowed to dry thoroughly before spraying is commenced. The daily douching is carried out by a standardised procedure.

Weighing.—The corrosion of the specimens is measured in terms of loss in weight per unit area after the removal of the corrosion products by means of Clarke's solution.

Using the foregoing equipment and *modus operandi*, two sets of spray tests on the fourteen materials were carried out, spraying with N/100 sulphuric acid.

Progress of the Tests and Modifications in the Apparatus

During the tests on N/100 sulphuric acid spray, difficulty was exper enced in maintaining a constant spray volume of equal intensity on the two faces of the specimens. This was due to the level of liquid in the spray bottles falling at slightly different rates during a day's run. The apparatus was therefore modified as follows :—Instead of using bottles of spray liquid and adjusting the spray pressure periodically, a large aspirator full of liquid is placed 10ft. above the level of the spray apparatus. The spray liquid is passed from the aspirator through a device (shown in the diagram) which ensures a constant flow of liquid, independent of either the hydrostatic pressure or the back pressure of the air blast. After passing through this device, the stream of liquid is split into two equal streams, each passing through a length of fine capillary tubing and thence to the spray nozzles. The spray liquid is converted into a fine nebula by the air blast, which is kept constant at a definite pressure.

Orders of Merit for Fourteen Steels and Irons in Field Tests and Three Types of Spray Tests at Stocksbridge

Material.	Field tests, 27/7/37 to 27/7/38.	Spray tests. - N/100 sulphuric acid, N/100 sodium chloride. Old equipment.	N/100 sulphuric acid, N/100 sodium chloride. New equipment.	N/100 sulphuric acid.	N/20 sulphuric acid.
Carbonyl iron ...	13	13	—*	1	10
Swedish Lancashire iron	14	14	13	13	13
Staffordshire wrought iron	9	8	10	12	7
Aston-Byers iron ...	12	12	12	14	14
Ingot iron	11	11	11	11	11
Rail steel	8	7	7	10	12
X K (0·2% C, solid)	7	9	9	8	8
Z K (0·2% C, 0·5% Cu, solid)	3	3	4	6	4
K (1% Cr)	6	6	6	6	5
L (0·6% Cr, 0·5% Cu)	2	2	2	3	2
N (1% Cr, 0·5% Cu)	1	1	1	1	1
O (0·5% Cu, 1·5% Mn)	4	4	5	5	2
X 2 (0·2% C, balanced)	10	10	8	9	9
Z (0·2% C, 0·5% Cu, balanced) ...	5	5	3	4	6

* Carbonyl iron was not tested in this series.

Two additional duplicate sets of tests on the fourteen materials were carried out on the spray apparatus modified as above, using (*a*) N/20 sulphuric acid, and (*b*) a mixed solution containing equal proportions of N/50 sulphuric acid and N/50 sodium chloride, *i.e.*, centinormal in respect of each constituent. The two sets of spray tests using the mixed solution were controlled at different spray intensities, and this is reflected in the loss-of-weight figures. It was found that the volume of sp ay li uid falling on the surface of the specimens does not affect materially the order of merit obtained. Duplicate field tests were also carried out for one year in the semi-industrial atmosphere at Stocksbridge (seven of the materials had been the subject of previous one-year field tests at Stocksbridge).

As a result of the good agreement between the long-period field tests and the sulphuric-acid/sodium-chloride spray tests, it was decided to build an entirely new equipment. This incorporates additional improvements, in that a direct drive through the gear-box is used instead of a belt drive, and the apparatus has greater stability, achieved by lowering the travelling belt and using metal and Sindanyo parts instead of wood. Also, the carbon filament heater lamps were replaced by a strip heater covered by a sheet of stainless steel. This was necessary to accommodate the drying section of the apparatus in the new lay-out and had the added advantage that the thermometer was not directly exposed to radiation from the carbon filament lamps.

The orders of merit for the fourteen materials in the field tests and the three types of spray tests are given in the accompanying table.

Consideration of the Results

In the first set of spray tests, using N/100 sulphuric acid, the orders of merit for certain materials were in reasonably good agreement with the field test results, but the "spread" of the results was of a very low order.

The mixed sulphuric-acid/sodium-chloride solution increased the "spread" of the results materially, at the same time giving orders of merit very close to those of the one-year field tests. The results of the new equipment tests show that the orders of merit for thirteen materials are reasonably close to those obtained in one year's atmospheric exposure.

Conclusion

In the view of the authors, the accelerated spray test described is of sufficient promise to be regarded as the basis of a laborato y method for the determination of the relative corrodibility of irons and constructional steels. The results have been placed on record for the main purpose of encouraging other workers in this field, who may consider it worth while to pursue the method with other spray solutions, or may introduce other modifications for the additional improvement of the method. It is well known that the relative corrodibility of ferrous materials differs in different types of atmosphere, and it is thereby feasible that a spray solution which gives the Stocksbridge or Sheffield order of merit may not be suitable for reproducing the order of merit obtained in urban or marine atmospheres. Further research in this direction is necessary.

American Engineering News

American Bridge Construction

The design and construction of large bridges continues to be a conspicuous feature of engineering work in the United States. In recent years several long bridges have been built across the Mississippi River, and three are now under construction. At Greenville, a highway bridge of the cantilever type has a central or main span of 840ft., with two side or anchor arm spans of 640ft. Its cost will be about £900,000—at normal rate of exchange. At Baton Rouge is another new cantilever bridge, but for both railway and highway traffic. A central span of 650ft. serves as the anchor span for two spans of 860ft., beyond which are two shore anchor spans of 500ft. A double-track railway will be laid between the trusses, while cantilever brackets on the outside of the trusses, forming extensions of the main floor beams or cross girders, will carry two roadways 25ft. wide. This arrangement was considered more satisfactory than to space the trusses far enough apart for two roadways in addition to the railway lines. The cost in this case will be about £1,700,000. The third bridge, at Natchez, is a highway bridge of the continuous cantilever type, covering five spans. The centre span of 875ft. is an anchor for two adjacent spans of 875ft. and 800ft., beyond each of which is a shore anchor span of 560ft. In this case the cost will be about £700,000. A highway cantilever bridge over Narragansett Bay has a 640ft. main span, flanked by two anchor-arm spans of 260ft. Beyond these at each end are three deck truss spans of 270ft., followed by 3600ft. of plate girder spans at one end and 700ft. of similar spans at the other end. A difficult job of reconstruction on the Portsmouth bridge over the Ohio River was the replacement of the old cables, in which broken wires had been found. The centre part of the span was removed and the remaining cantilevered ends were held by cables from the towers.

American Cement Specification

A standard specification for Portland cement was adopted in the United States some thirty years ago, and has remained in force until its revision in 1940. Meanwhile, a great number of modifications have been introduced for special purposes, and there has been a growing demand for recognit on of the fact ,that one kind of cement is not of universal application under all conditions or for all kinds of structures. At the annual meeting of the American Society for Testing Materials, this situation was remedied by the adoption of specifications for five different classes of cement. They cover the following —First, a normal or general-purpose cement ; second, a moderate-heat cement ; third, a high-early-strength cement ; fourth, a low-heat cement ; and fifth, a sulphate-resisting cement. This action is the result of co-operation between manufacturers of cement and engineers who specify and use the cement. In a lecture at this meeting it was pointed out that many essential facts as to the constitution and behaviour of cement are still unknown, so that a wide field is open for further study and research. In fact, according to the lecturer, there is not only an outstanding lack of needed physical tests, but also an equally outstanding lack of definite effort to develop such tests. This statement may seem strange in view of the continual and elaborate studies of cement. But a large proportion of this research work has related to the production of special cements for concrete structures demanding special consideration. Thus, in the huge concrete dams for irrigation and flood control, the question of low-heat and high-heat cements has been of vast importance. With the further study now advocated there should be developed better cements and better concrete, or concrete better adapted to meet various conditions with higher efficiency and economy.

American Concrete Specification

In timely accord with the new specifications for cement, noted above, are the new standard specifications for concrete, issued by the American Society of Civil Engineers, and revised from the original issue of 1924. They include recommended practice and are designed to cover the use of concrete and reinforced concrete, using high-early-strength cement ; but it is recognised that special cements may be desirable in many cases. Aggregates are treated comprehensively, and this section covers the use of lightweight aggregates and the classification of aggregates in two lists on the basis of fire-resistant properties. Emphasis is placed on durability of concrete. The increased strength of modern cement and the improvements in concrete technology make it possible to produce concrete having sufficient strength for ordinary purposes with a water content too high for many types of exposure. It is considered that classification of concrete based on the character of exposure will be more generally useful than if based on the common requirements of minimum strength. Special attention is given to factors which affect workability and the production of a dense and homogeneous concrete. For proportioning, two alternative methods are presented : First, where the contractor is required to produce concrete of a specified quality and is given considerable freedom of procedure, and secondly, where the engineer specifies the proportions required, including a minimum cement content. In relation to design, special consideration is given to the increasing use of the principle of continuity and the elastic frame analysis. Since reinforced concrete construction is essentially monolithic in character, these newer methods are aimed at a more rational and better balanced design. Methods of frame analysis can be used in ordinary building design without excessive computation. Safe loads for columns are based on the ultimate strength of the concrete and the yield point strength of the longitudinal reinforcement, using the full gross area of the column.

Self-anchoring Suspension Bridge

In this type of suspension bridge—which is rather unusual, but has been used in several cases in the United States—there is no massive anchorage for the cables, but their shore ends are attached directly to the longitudinal trusses or girders. A recent example of this design is a highway bridge of 350ft. central span over the Wabash River, having shore spans of 150ft. Dead load is 2660 lb. per linear foot of bridge in the main span and 2860 lb. in the side spans. Each cable consists of nine separate 1⅛in. twisted wire strands of 270,000 lb. ultimate strength, each stressed to 67,000 lb. per square inch for combined dead and live load. The suspenders are single 1⅛in. wire cables. To avoid complications in the design of the ends of the stiffening girders, which are silicon steel 36in. H beams or wide-flanged rolled joists, the cable connections are made at one bay or panel point from the end of the girder. Here the nine cables end in sockets fastened between four parallel plates whose outer ends are attached to brackets on top of the girder by means of a 9in. pin. In this way the cables and girders form a closed circuit. The towers are simple gallows-frame structures, with legs of 36in. H beams connected by transverse members and diagonal bracing. They have roller-bearing supports or seats on the concrete piers. As no longitudinal movement is permissible for the suspension structure, all expansion and contraction in the entire length of 1005ft. for bridge and approaches is taken at a single joint between the bridge and an approach viaduct. The gradients are about 1 in 20 on each side. A roadway 20ft. wide has a floor of steel grids or gratings filled with concrete 4½in. thick and made with a light-weight aggregate. Along each side is a narrow footwalk. The grid work is welded to the floor framing.

The Engineer

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CHANGES OF ADDRESS

**** Will Subscribers please note that in all advices regarding changes of address it is necessary to have* **both the old and new addresses,** *as our lists are kept alphabetically by towns. Advices of this nature should reach us by the first post Wednesday morning prior to the alteration.*

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WEATHER AND FLYING

THERE is a story, none the worse for being true, of a young meteorologist, since eminent in the scientific world, who was bold enough to offer his services to an important General (this was in 1914), only to meet with the rebuff that he ought to know that the "British Army would fight whether it was raining or not," so that there was certainly no need for him or his forecasts. The attitude to weather in war time is now very different, and even the least scientifically minded realise that to ignore it is to risk disaster. In this part of Europe the weather usually comes from the west, giving us an advantage over the enemy when making forecasts. That half of the weather map which Germany can construct happens to be the wrong half. Ours is the right one, and this is an advantage as real as it is welcome. Although the higher air speeds now attained make some of the effects of weather conditions of less effect, in other ways precisely the opposite holds.

One of the remarkable features of air warfare in 1914–18 was the exceedingly accurate air navigation carried out by the R.N.A.S. in their daily anti-submarine patrols. These aircraft had to fly on what were appropriately called spider-web patrols, and to keep a log of their positions so accurate at all times that at the end of many hours' flying they would be able to make a correct landfall near to their home base with a reserve of petrol still in their tanks. With air speeds which rarely exceeded 100 miles an hour, this was a fine achievement, even when aided, as it often was, by the naval experience which so many of the personnel already possessed. In these days, with air speeds fully three times as great and fuel capacity much more, the effect of "drift" due to a given wind is lessened by two-thirds, which makes the navigation much easier. On the other hand, the tasks imposed have naturally grown more onerous with the ability to achieve greater things. These higher air speeds have been due in part to the greater engine power available, but, as was stated by Dr. Heinkel, the well-known German constructor, some years ago, much the greater part of the improvement is known to be due to the better streamlining of the wings, fuselage, and other structural parts of the aeroplane proper. Herein lies a weakness, for ice accretion upon the wings, which the coming of winter must enhance, will greatly reduce the high lift to drag ratios on which designers depend, and lower the flying performance to a far greater degree than it would have done on the older types of design. It is natural to wonder how far in other ways the coming of wintry weather will affect the flying operations of the war, either on our part or on that of the enemy. To this there are two aspects. The first requirement is to arrive at or close to the designed destination, even on the most overcast of days, and the second the carrying out of the allotted task when there. The former is easier for us, since dead-reckoning navigation will certainly be aided by the possession of the more complete weather forecasts. Radio direction finding, useful and effective in days of peace, can be made so baffling by military ingenuity that it is an uncertain factor on which to rely in war. Astronomical navigation is in principle equally available to both sides, but it presents inherent difficulties in stormy weather. The higher air speeds of to-day make navigation easier by shortening the time of flight for a given distance, and lessening the drift caused by uncertainty about the wind, but, on the other hand, the longer flights now possible over enemy territory are bound to prove tiring, especially in wintry conditions. The accuracy with which the task can be carried out when the objective has been reached requires that the actual target shall be quite definitely identified, a far-from-easy task, even on days less stormy and overcast than those that are coming, as many recent enemy claims bear witness. Hitting the target when it has been found requires an accurate knowledge of ground speed and altitude, and here weather is an important factor. The measurement of either element calls for the use of instruments capable of giving a fair mean, however unsteady the conditions may be. But this, even when accurately done, does not ensure that at the moment of bomb release the instantaneous values of either ground speed or altitude will have those average values, the less so, indeed, as the air itself is the more disturbed. Such atmospheric unsteadiness derives from many causes. One of the most important is the fluctuation of air temperature with altitude—known as the lapse rate, and on the average some six or seven degrees Centigrade for each kilometre of ascent. When the rate is below this, the turbulence is usually less and the bomb-aimer's readings the more dependable; but when the rate is high, and it may exceed the above average by half as much again, the vertical and horizontal components of the turbulence become so considerable that accuracy in aiming is bound to suffer.

Such weather conditions affect our R.A.F. particularly, for although they will not prevent the objective from being reached, they will certainly make it more difficult to hit. That same difficulty will also be felt by the *Luftwaffe* in so far as they are instructed to follow the policy of aiming solely at military objectives (as Goering at one time promised), but if a mere scattering of bombs entirely at random over any large city is the sole objective, even disturbed weather conditions can prove little hindrance. But that is not the way to win a war.

New Steel Distribution Scheme

IN April this year a scheme for the distribution of steel of an entirely new character was brought into operation. The intention was to conserve the use of steel for purposes essential for the carrying on of the war, and whilst it has gone a long way to meet the purposes for which it was designed, it has been realised that it did not go far enough, and that a certain amount of steel was still used for non-essential purposes. It was stated in April that the scheme would be given a trial and that the experience gained in working it would be used later to bring it, if necessary, into a more practicable and efficient shape. On September 25th the Iron and Steel Control fulfilled its promise, and the second edition of the scheme was published. Whilst retaining the principal feature of the original scheme, it is designed to simplify its working and tighten up some of the leakages which have become apparent. One of the most important alterations, which is intended to prevent more steel being obtained than is actually required for any one contract, is the provision ensuring that a reference number will be incorporated in an authorisation form signed on behalf of any Government Department by the official responsible for placing the contract. A contractor employing a sub-contractor will have to give a similar authorisation. It is pointed out that where there is a direct authorisation from a Government Department, a licence (which automatically includes a Board of Trade symbol from the Iron and Steel Control) is necessary, and that this licence number must be quoted instead of the Department authorisation just referred to. The needs of the home civilian trade will be met by licences authorising the purchase of finished steel issued by the Iron and Steel Control, which will also issue licences for direct export trade and stockholding merchants (or to replenish stock for home civilian trade and direct exports). Manufacturers who use stock for the home civilian trade and for direct export or stockholding merchants should take note that they cannot replenish stock without an Iron and Steel Control licence. Supplies for stockholding merchants for stock, it is pointed out, "are intended primarily for sale only for essential purposes for home civilian trade."

The control of civil building and constructional operations has already been the subject of a memorandum by the Office of Works, and the new distribution scheme warns contractors and their suppliers who have obtained authority from a customer to quote a symbol authorisation number and period number to acquire constructional steel that this authority covers the acquisition only of constructional steel "and not the securing of the steel necessary to carry out the job." It is also expressly stated that supplies of finished steel for the stock of a structural engineer will be authorised only by Iron and Steel Control licences, and will in general be restricted to a maximum of 50 tons per month. Whilst applications to acquire the steel from mills or stockholding merchants must be submitted to the Iron and Steel Control, steelwork other than that for inclusion in a building may be obtained from mills on the authority of a symbol, &c., without the necessity of the manufacturer or fabricator obtaining a licence from the Control. In a memorandum upon the use of symbols in steel distribution, it is claimed, with justice, that this system has facilitated the working of the Iron and Steel Control, and that the allocation of steel supplies has been simplified. The system covers "every possible use of steel, whether for the replenishment of pins, or steel for the construction of a battleship." The use of symbols in the past has not been thoroughly understood by consumers of iron and steel and there have been difficulties. It is therefore desirable that it should be clearly understood that, in the words of the Iron and Steel Control, "each Government Department is allotted a fixed quota or a ration of finished steel. The right to use a Department's symbol means in effect the right to use a portion of that Department's ration of steel." As illustrating the system, an example is given of the Board of Trade which is responsible for the steel needed for many civilian requirements. Consequently, the symbol B.T. must be used in the case of steel for bicycles, steel brads for boots and shoes, and so on. The Board of Trade being responsible for exports, its symbol must be used in this branch of the trade as well. It should be clearly understood, however, that symbols "can only be used following written confirmation by the Department concerned. No errors can occur if the main contractor secures this autho-

rity when obtaining the necessary allocation of steel." Sub-contractors should obtain a symbol in writing from the main contractor for their part of the job, except in the case of purchases from a stockholding merchant.

The Iron and Steel Control must be credited with thoroughness in familiarising the trade with the requirements of the scheme, and a booklet, entitled "Distribution of Steel Supplies," is being published describing the new scheme in detail. Application for it should be made to the Registry, Iron and Steel Control, Steel House, Tothill Street, London, S.W.1. This booklet is divided into six sections, entitled (*a*) General; (*b*) Placing of Orders for Finished Steel; (*c*) Building Contracts Placed by or for Government Departments; (*d*) Purposes not being Government Contracts; (*e*) Purposes Covered by Iron and Steel Control Licences; (*f*) Supplies for Building Purposes.

Obituary

SIR ROBERT HADFIELD, F.R.S.

We have to record with regret that Sir Robert Hadfield, Bt., F.R.S., &c., died at Kenry House, Kingston Hill, Surrey, on September 30th at the age of 81. An obituary notice with portrait will appear in our next issue.

Consideration for the Worker

(*Contributed*)

In war-time additional effort is required from everyone, and from no one more than the engineer on whose unabated energies the issue is largely dependent. A maximum output is expected from the factory, and the worker is enjoined to give of his best and to work long hours. Too often the employer's attitude is one of indifference to his employee, arguing that if long hours are worked payment is made for long hours, and the man has no cause for complaint; indeed, he should rather realise that he is exceptionally favoured in that he is making good money while others fight their country's battle in a more exacting and dangerous way. While this may be true in measure, such an outlook is a very narrow one. Long hours and maintained effort produce a work-weariness which is liable to have a most prejudicial effect, but fortunately this very weariness can be largely mitigated by careful consideration for the worker by those in authority.

Much has been written since the last war on the subject of motion study as a means to increase output, but there is also the important fact that a careful study of every movement tends greatly to lessen the fatigue of the operator, which in turn improves his mental attitude to the work in hand. The work should be so arranged as to ensure a minimum of movement for a maximum result. Many managers are prone to consider that anything that savours of comfort savours also of a lack of the discipline that they consider so essential to the efficient workshop. That this is not so is demonstrable; as an example, it is suggested that in all cases where it is feasible seats should be furnished for those machine operators whose attention to their machine is intermittent in character. There was a time when a machine required constant attention, but in the present mechanical age, so much is done for the machinist that there are long periods during which relaxation is possible, a state which a wise management will encourage. Furthermore, seats can be so designed as to give a maximum of rest, and be arranged positionally so that a close watch can be kept on the running of the machine. Far more attention might be paid to the many factors that contribute to produce a harassing effect on those in the workshop, and perhaps one that is ignored more than any other is that of noise. It is regarded as almost axiomatic that a workshop must necessarily be a noisy place, whereas in reality there is much noise that is unnecessary and that can be eliminated, thus helping to render the plant more efficient, and at the same time machine shop conditions more pleasant. Often noise is a warning of mechanical defects which require attention, or there will be a serious risk of accident. The elimination of accidents is largely in the hands of the management, who should be alive to those steps that should be taken, and more especially in the cases where unskilled labour is employed. It is those firms that have the welfare of the worker most at heart that have the lowest number of accidents.

It is astonishing to discover how much needless walking is undertaken by industrial workers, resulting in much dissipated energy which might well be diverted into more productive channels. There is walking to the tool room, walking in search of a foreman or inspector, and many another journey, which a considerate management will do well to investigate and reduce to a minimum. The worker appreciates that he is not earning when he is away from his machine, and accordingly unnecessary walking tends to foster a spirit of resentment. It is a recognised fact that definite rest periods reduce fatigue, and not only increase output but tend to banish that pessimistic day dreaming that is so destructive to a state of contentment in the workshop. An employer proved that by supplying a cup of tea both in the morning and evening for all his people. Not only was the general tone improved, but at the same time the actual output was materially increased. Yet there are still many firms that relegate such facilities to the category of offences, although probably conscious that the practice is maintained regularly, in spite of their prohibition. Similarly where smoking has been permitted during working hours, it has proved not only not to impair production, but actually to increase it.

Too often but scant attention is paid to the self-respect of the worker, and in many ways this country lags behind others in the amenities provided. There is certainly no reason why the manual worker should not be able to go to work as well dressed as his brother who is a clerk in the office; he should be afforded opportunities of changing into working attire on his arrival, and after his round of work he should be able to enjoy a good wash and brush up before getting into his home clothes again. The shop in which he works should also be kept spruce and tidy, with method in evidence everywhere, and with clearly marked gangways for the transport of goods, all tending to preserve that feeling of general comfort and well-being that will soon be reflected in all the staff.

It may be objected that the few instances we have cited of consideration for the worker are but trivial; the contention may be just, but the best part of our daily life is made up of incidents trivial in themselves, but cumulatively very important; indeed, it is by a careful study and adjustment of the small things that the larger issues frequently have a way of taking care of themselves. It is an easy matter to urge the necessity for fostering harmonious relations in office and workshop, but it is doubtful whether it can ever be accomplished without a spirit of understanding and co-operation, an ability to put oneself in the place of the man on a lower rung of the official ladder, and to make a point of showing him consideration to the extent of not asking him to do things that one would object to undertake in similar circumstances.

Letters to the Editor

(*We do not hold ourselves responsible for the opinions of our correspondents*)

BOONDOGGLING

Sir,—I was interested in your leading article on "Boondoggling." There is one inaccuracy in this article to which I must draw your attention. You say "Every schoolboy in the land of freedom—of speech—knows, and we do not."

The fact is that when I was in the States some time ago I encountered this word in the daily Press, and, like yourselves, was completely ignorant of its meaning. I promptly proceeded to question various American friends, including the heads of our American agency, and it was only at about the fourteenth attempt that I obtained a slight clue to the meaning of the word.

It appears that under the New Deal, which was then in force, certain sums of money were granted to enable actors, artists, writers, &c., to receive relief, in return for which they gave certain public performances, which, I believe, were either free or at a very low price. This perfectly laudable attempt by the United States Government to keep some of its most valuable citizens from starvation was probably regarded by the harder-headed members of the community as "larking about with public money." It is possible that there may have been some abuse of the grants, and this devotion of public money to what was regarded as more or less play became known as boondoggling—in other words, squandering public money on trivialities.

I am not going to take a solemn oath that this is the exact meaning, but it was all I could gather in the States.

I think you will agree, in view of this, that not every American schoolboy knows the meaning of the word.

Edgar Allen and Co., Ltd.,
Eric N. Simons,
Publicity Manager.

Sheffield, September 24th.

Sixty Years Ago

The Canadian Pacific Railway

In our issue of October 1st, 1880, we reviewed a "Report and Documents in reference to the Canadian Pacific Railway," by Sandford Fleming, C.M.G., Engineer-in-Chief. The report published in Ottawa was a State document, presented to the Marquis of Lorne, Governor-General of Canada, and intended to be submitted to the Canadian Parliament. After numerous delays the final arrangements had been made for carrying out the immense task of connecting by railway the Atlantic and Pacific coasts of Canada, or British North America, as the territory outside the provinces of Quebec and Ontario was still called. A similar task had already been accomplished in the United States by the successful completion of the Pacific Railway. That line, with the aid of modern methods and machinery, had been constructed at a rate beyond all precedent through a country in many parts wild and barren, and inhabited by marauding tribes of hostile Indians. Advantage, it was stated in the report, would be taken in the construction of the Canadian Pacific Railway of the experience gained in the United States, but it was asserted that the task which Canada had undertaken was far more formidable than that which had been accomplished in the United States. Some of the difficulties were financial rather than physical. The American line had been largely inspired by the gold discoveries in the west. There was no visible El Dorado at the western end of the Canadian Pacific. The boundless financial resources of the United States were not at the disposal of the British North American colonists. Only a small portion of the length to be traversed, whatever route was ultimately chosen, would lie through country already inhabited and settled with produce supporting the railway or offering great temptations to early settlements in the Far West. Nevertheless, it was felt that the time had come for a second line across the Continent, one situated entirely in British territory and under British control. It was anticipated that the new line would attract large bodies of emigrants passing from the Old World to the Pacific coast of the New World. In addition, there was the possibility of discovering vast mineral wealth in the mountain fastnesses which the line would traverse, and of opening up new fields of food supplies to be conveyed from the Pacific across Canada to Europe. The salmon alone of the Columbia River would form the basis of a very large food trade. About one-third of the entire distance to be traversed would be provided by the lines already existing at the eastern end, after they had been united and adapted for a great trunk traffic. As for the physical difficulties in the way of the project, there were none of a very formidable or expensive nature eastwards of the Red River. Beyond that point the Rockies presented a barrier through which several alternative routes had been prospected. Sandford Fleming, in his report, gave it as his opinion that the Yellow Head Pass was a definite governing point by which the whole location of the line would be controlled. The route beyond that Pass should, in Fleming's view, be given further careful consideration, but if an immediate decision were necessary he would recommend the route by the Thompson and Fraser rivers to Burrard Inlet, and the rejection of the scheme to carry the line to Vancouver Island. An important factor in this recommendation of Fleming's was doubtlessly the fact that a few years previously the United States had seized the island of St. Juan for the purpose of blocking the mouth of the Columbia River to British shipping in the event of war.

BOOKS RECEIVED

Engineering Drawing. By W. Weeks. London: Percival Marshall and Co., Ltd., 60, Kingsway, W.C.2. Price 2s.

Annual Report (Technical) of the Central Board of Irrigation, India, 1938–39. India: Central Board of Irrigation, Simla.

Engineering Workshop Manual. By E. Pull. London: Technical Press, Ltd., Ave Maria Lane, Ludgate Hill, E.C.4. Price 4s.

Applied Chemistry for Engineers. By E. S. Gyngell. London: Edward Arnold and Co., Ltd., 41–43, Maddox Street, W.1. Price 15s.

The Materials of Aircraft Construction. By F. T. Hill. London: Sir Isaac Pitman and Sons, Ltd., Parker Street, Kingsway, W.C.2. Price 20s.

Waste Wood Destructor

THE disposal of wood waste has become increasingly difficult in the last year, necessitating a recasting of current practice. Wood waste cannot be allowed to accumulate in sawmills and factories. Even a day's waste, if not removed, would noticeably slow production, while a little more would choke the entire productive machinery and bring it to a standstill. Sometimes waste of this type is carted away for dumping or, more usually, wholesale incineration. This procedure has the disadvantage that shavings, by reason of their bulk, form uneconomic loads, since a lorry load does not use fully the lorry's rated

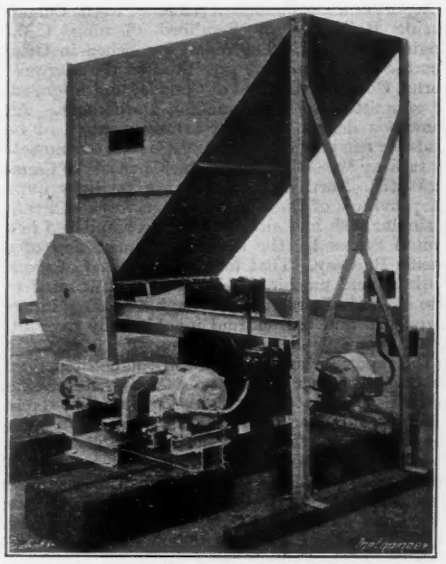


FIG. 1—REFUSE DESTRUCTOR UNIT

capacity. Consequently, the cartage contractor has to charge at a rate higher than that for handling less bulky material. In war time the position is aggravated because many vehicles have been withdrawn from commercial service, and it is difficult to get material moved at all. Again, those contractors who used to burn such waste on large open dumps have to make other arrangements in many cases owing to defence regulations. As a result there has been increased interest in economic methods of small-scale incineration, and improvements have been made in the disposal of wood waste by burning in furnaces.

The photograph reproduced in Fig. 1 shows the Nesfield Deane wood refuse destructor, marketed by the Fisher Deane Engineering Company, Ltd. It consists basically of a mechanical hopper feed and a combustion chamber in which the chips are burned. The hopper receives shavings, sawdust, &c., generally collected by a cyclone from the workshops. The waste is then metered from the bottom of the hopper by a drum with obstructions on its surface revolving at between 3 and 12 r.p.m. The chips then pass into an air stream set up by a blower delivering air at a suitable velocity and volume according to the quantity to be dealt with, and subsequently into the ductwork and combustion chamber of the furnace. The meter drum is driven by a 1½ H.P. Crompton Parkinson motor through a Croft's variable drive, while a similar motor drives the blower.

The air-borne shavings impinge in the furnace on a refractory brick bridge so that they are thrown up and back, being burnt while still in the air. The design of the chamber provides complete combustion of the waste at about 15ft. from the feeding point, the products of combustion taking the form of high-temperature gases, reaching a temperature of 11/1200 deg. Cent. at this point. The capacity of the units is governed by the air speed and the meter drum speed, while it is increased by the embodiment in the design of an adjustable lip which, by reason of its position in the air stream, produces a vacuum effect which draws the chips by suction; 1½ tons an hour can easily be dealt with by a standard unit. These units will take up to 10 per cent. of sawdust with the chips.

It is under some conditions inevitable that some pieces of wood too large to pass the meter drum will be deposited in the hopper.

To prevent such material from jamming and damaging the loader a spring-loaded trap is provided which is forced open by any piece of wood which is too large to pass. The unit, in fact, is foolproof, requiring the minimum of attention.

A 1½-ton per hour installation, we are informed, costs about £1500 to install and requires little maintenance. It is claimed that the savings on cartage amount to a handsome return on the capital outlay, taking an average output of 1 ton per hour for a fifty-hour week. For comparison, the makers' state, the cost of removal can be taken as 10s. a ton (including handling in sacks), entailing an outlay of £25 per week, and at this rate the cost of an incinerating plant of the Fisher Deane type would be covered in just over a year. This comparison assumes that no use is made of the products of combustion in the furnace.

Actually, the result of this combustion produces high-temperature gases that reach 1100 deg. Cent. By the introduction into the circuit of a waste heat boiler some 4000 lb. of steam can be raised from every ton of waste consumed.

The drawing, Fig. 2, and engraving, Fig. 3, illustrate an installation of destructors at the Millwall works of Montague Meyer, Ltd. This plant consists of two stokers running in parallel and feeding into a combustion chamber rectangular in shape, with internal dimensions of 8ft. by 8ft. The grate area provided is 68 square feet.

The flow of gases after combustion of the waste wood is, in this case, made to take a change of direction owing to the rectangular shape of the combustion chamber, and, it will be observed, on reference to the engraving, that the two stokers feeding the combustion chamber are more or less in line with the chimney, the square plinth with the step irons being clearly seen on the left-hand side of the picture. There are hand-firing doors to right and left of the mechanical stokers in the side walls of the combustion chamber and over the grate.

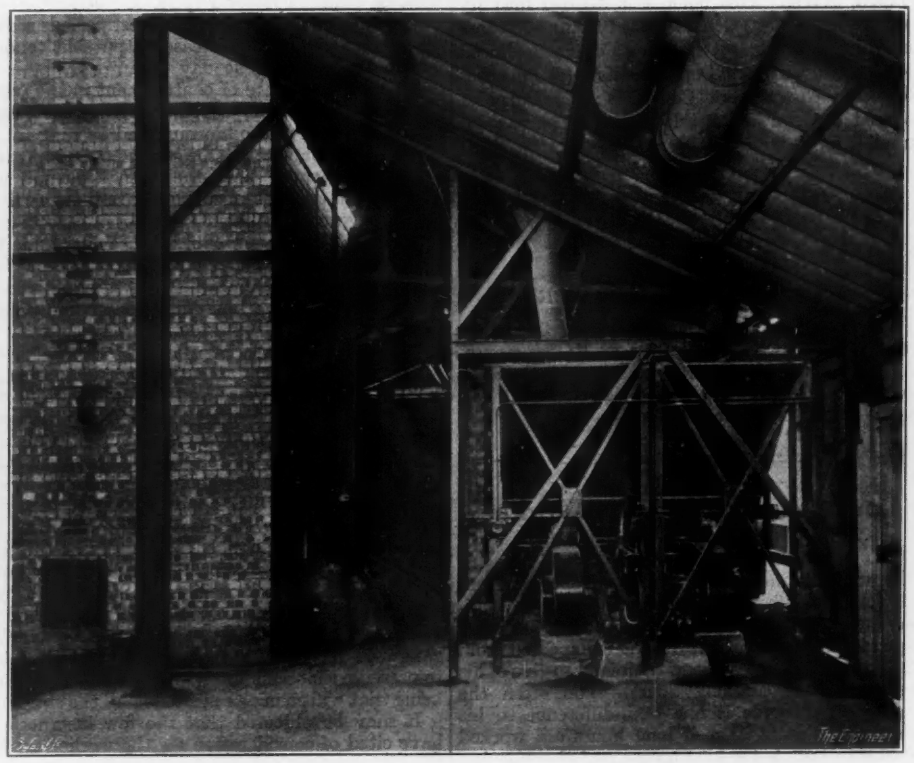


FIG. 3—INSTALLATION OF WASTE WOOD DESTRUCTORS

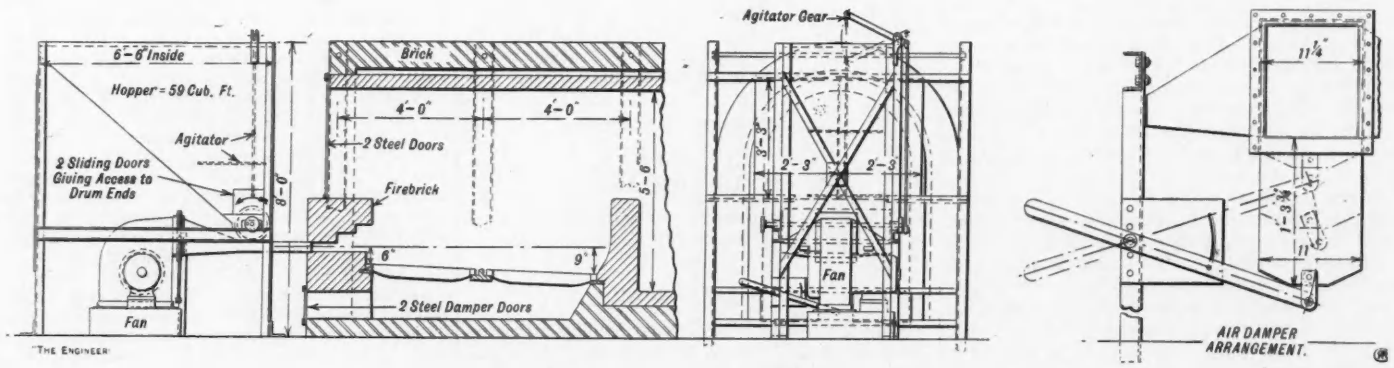


FIG. 2—ARRANGEMENT OF WASTE WOOD DESTRUCTOR

This destructor plant is fitted with a large "dowsing" tank situated beneath a curtain wall, and the gases impinge on this wall and are deflected down to the tank where all flyers are collected, and the gases then pass up the chimney. The plant is dealing with 3 tons per hour, the material weighing about 4½ lb. per cubic foot.

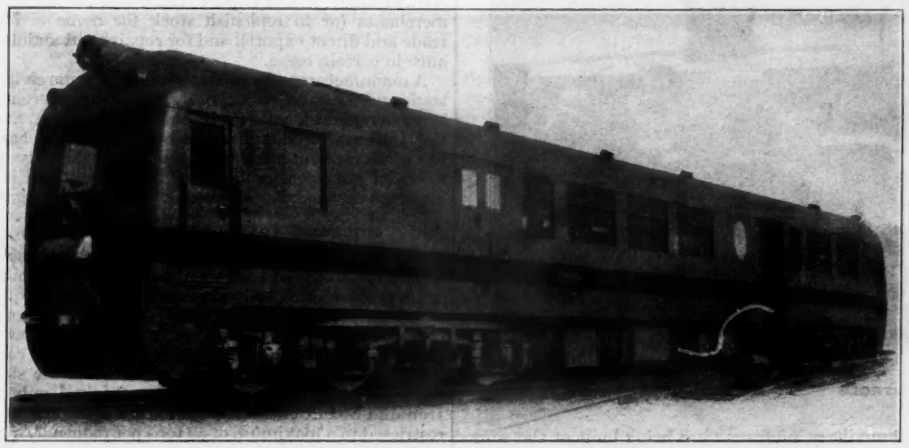
DNIEPR AND DONETS HIGH-TENSION TRANSMISSION LINE.—The opening took place recently of the largest power system in the Soviet Union, linking up the Dniepr hydro-power station with the power stations of the Donets coal basin. Current generated by the Dniepr River was for the first time carried along high-tension transmission lines to the industrial enterprises of the Donets Basin. The new transmission lines have a tension of 220,000 volts and extend for more than 155 miles. During the spring when the Dniepr River is at a high level the Dniepr hydro-electric station working at full capacity will send its surplus current to the Donets Basin. At low water levels on the Dniepr the steam power plants in the Donets Basin will supply current to the regions which cannot be served by the Dniepr station.

Railcars for New Zealand

TEN diesel railcars ordered by the New Zealand Government Railways from the Vulcan Foundry, Ltd., of Newton-le-Willows, are now in course of completion, and a number have already been shipped. All the cars are identical as regards their construction and equipment. The cars have an overall length of 66ft. 3in. and the leading dimensions are as follows :—

	Ft.	in.
Length over cow-catchers	66	3
Bogie centres	42	6
Power bogie wheel-base	12	0
Carrying bogie wheel-base...	10	0
Overall height	11	3
Overall width	8	8½
Gauge	3	6

The tare weight with fuel and water is 36 tons and the laden weight with a full complement of passengers, crew and luggage 40·5 tons. The cars are of the double bogie type, a single engine and transmission being mounted in the three-axle bogie at the luggage compartment end. The carrying bogie has two axles. An unusual feature of the power bogie is that the centre axle is fixed and fitted with flangeless wheels. The engine and transmission are controlled from either one of the two driving positions situated one at each end of the railcar.



250 H.P. DIESEL RAILCAR FOR NEW ZEALAND

The cars are designed for running in multiple unit. Two coaches may be coupled together and the two engines and transmission systems controlled from either end of the two-car unit. Control of these multiple power and transmission units is carried out by a remote control system. The engine speed between idle and full is controlled pneumatically, and positive and synchronised operation of the change speed and reverse gears is carried out through a simple system to be described later. With the engines running at their maximum governed speed (1000 r.p.m.) the following are the maximum speeds obtained on the various gears after allowing for slip through the fluid coupling :—14·0, 20·0, 35·0, 51·0, 75·0 m.p.h. Seating is provided for fifty-two passengers in two compartments separated by an entrance vestibule. A toilet compartment is provided in one compartment. A separate driving compartment is provided at each end of the car. Immediately behind this cab at the power bogie end is the engine-room, followed by the luggage compartment. Suitable doors enable the staff to traverse the full length of the car.

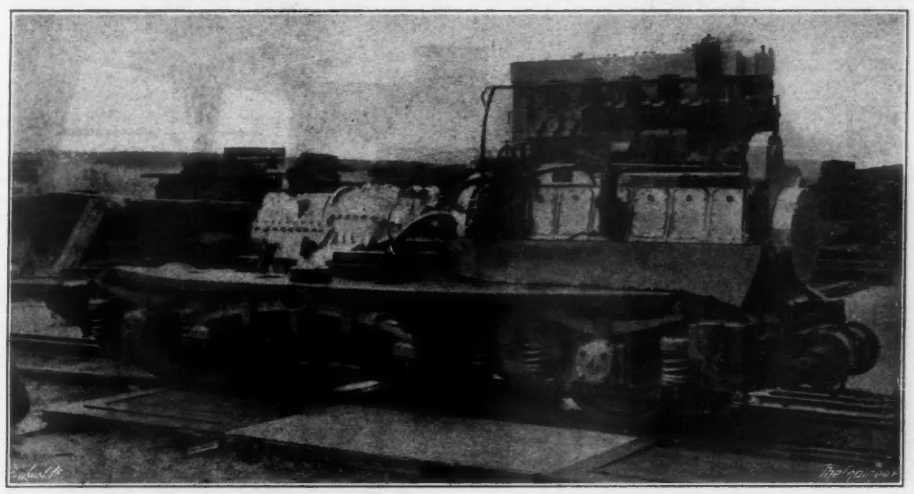
The underframe and body of each car form an integral all-welded structure having pillars, carlines and purlins of the "top-hat" section and the cant-rails are of double angle section to allow for the roof framing being constructed and jigged separately from the side framing. The main solebars of the under frame are centrally disposed and run from end to end of the car and are well cross braced and stayed. The side and roof panelling is of steel sheets, spot welded to the framing, the coach exterior being flush sided and devoid of mouldings. Carried in the underframe are the main fuel and water tanks, batteries, air reservoirs and an auxiliary sub-frame on which are mounted the compressor, dynamo and engine cooling water radiators and fan drive.

Power and Carrying Bogies

Both the power and carrying bogies are of all-welded construction. The body weight is transferred through side bearers and long laminated springs to the bogie side frames. Mounted on the three-axle power bogie is one Vulcan-Frichs 250–275 H.P. at 1000 r.p.m. diesel engine. The drive is transmitted through a Vulcan-Sinclair coupling and a Wilson five-speed gear-box to the outer axles by means of Layrub cardan shafts and David Brown spiral bevel final drive gear-boxes mounted on the axles. The axles run on Skefko spherical roller bearings, and in the case of the centre axle of the power bogie, which is fixed, the wheels are also mounted on Skefko spherical roller bearings. Both engine and gear-box are supported at three points on the power bogie frame and the engine supports are provided with rubber mountings of special design to absorb vibration. To accommodate any relative movement between engine and gear-box in service a Standage flexible coupling is provided.

Auxiliary Sub-frame

The auxiliary machines are mounted on a separate sub-frame suspended from the main underframe approximately midway between the bogies, and these units are driven by power taken from a special output shaft in the gear-box which, being geared to the input shaft, always runs at a speed proportional to engine speed. The gear ratio is 1 : 1·19, so that the auxiliary shaft runs at 1190 r.p.m., corresponding to 1000 r.p.m. of the engine, but allowing for the slip in the hydraulic coupling the speed of the auxiliary shaft under full load conditions is about 1150 r.p.m. The drive from the gear-box to the auxiliary frame shaft is by means of a cardan shaft fitted with Hardy Spicer couplings. At the end of the auxiliary shaft there is a bevel gear-box, which drives the cross shaft for the two radiator fans. The auxiliary shaft and cross shafts run in ball or roller bearings and flexible joints are provided to take care of any deflections in the supporting frame in service. In addition to the radiators on the sub-frame there is mounted a Stones 24-volt self-ventilated dynamo, together with a Westinghouse air compressor of 26 cubic feet capacity, both machines being driven from the auxiliary shaft by multiple Texrope belt drives. The air intake to the compressor is taken from the top of the luggage compartment, whilst the ventilating air for the dynamo is drawn from inside one of the passenger saloons. The air for the engine is also drawn from the top of the luggage compartment through a suitable filter. As the cars may have to work in a dusty atmosphere it was desirable that all air intakes should be as high as possible above the track.



POWER BOGIE

Engines

The Vulcan-Frichs six-cylinder vertical diesel engine develops 250 H.P. at 1000 r.p.m. continuously and 275 H.P. at 1000 r.p.m. for one hour. The engine has overhea dvalves operated by push rods. Cylinder bores are fitted with wet liners and the pistons are made of special aluminium alloy suitably heat treated. Fully floating gudgeon pins are locked into position by aluminium pads at each end. Warning lamps are fitted on the driver's instrument panel for lubricating oil pressure and water temperature, but apart from these lights the engine is automatically safeguarded against lubricating oil failure by the governor, which is servo operated by the oil pressure. In the event of the pressure falling to a dangerous extent it at once stops the engine.

There are two water cooling Coventry radiator units on the auxiliary sub-frame. They are placed one on either side facing outwards so as to be dependent upon the fan for air flow and unaffected by the direction in which the car is running. The radiator units are provided with a series of pivoted vanes on the outside which can be turned through 180 deg. Apart from the water in the engine, radiator and car heating system, there is a tank of 34 gallons capacity in the roof of the engine-room. This tank is fitted with a level indicator facing into the driver's compartment. The water in the cooling system is circulated by means of a centrifugal pump mounted on the engine bed frame and driven by V belts from a pulley fixed to the hydraulic coupling.

The engine governor is mounted on the same platform as the fuel injection pump and is driven from the end of the injection pump camshaft. It is designed to control the engine at idling and maximum speed, but in the middle range has no influence on the fuel injection, which is entirely controlled by an air-operated piston under the control of the driver. The control rod which operates on the fuel rack is extended through the pump and comes up against a stop when the fuel injection corresponding to full load is reached, the end of the rod being provided with a roller which presses against a wedge. When overload is required from the engine this wedge is raised a definite amount by means of a solenoid operated by an electrical contact on the driver's throttle control valve, contact being made when the valve is moved beyond full load position.

The engine speed control or throttle is pneumatic between idling and full speed, being operated by an air cylinder to which air is admitted at varying pressures from a train pipe. The pressure of air in the train pipe is determined by the degree of movement of the manual control at the driving end, so that the response on one or two engines is in all cases directly proportional to the opening or closing of the manual control. A deadman's feature is embodied in the control, whereby sudden release of the deadman's pedal—as in the event of a human failure—causes the emergency valve to be opened, thus applying the train brakes, bringing the engine speed down to idling, and putting the gear-box into neutral. Control movements in the speed change and reverse gear-box are also effected pneumatically, but here the admission of air to the various operating cylinders is through a series of electro-pneumatic valves or "magnet valves," which are mounted directly on the gear-box. Connections from the magnet valves to the gear controller at either end comprises simple electric circuits, and as the valves are mounted directly on the gear-box the necessity for flexible air connections—so often a cause of trouble—between the bogie and the body is dispensed with.

Brakes, Electrical Equipment, and Heating

The braking is on the Westinghouse straight air-brake system with an emergency feature, which provides automatic application of the brakes should there be a loss of air from the emergency pipe due to a break away or other cause, such as placing the brake valve handle in emergency position, the opera-

tion of the passenger emergency valve, or the release of the deadman's pedal.

All electrical circuits for the controls may be isolated by a removable key on the gear-box master controller which can be inserted or withdrawn only in the "off" position, so that when the key is removed the controls at that desk are isolated and immune from outside interference. The controls for the driver have been kept as simple as possible and comprise a pneumatic control for the engine speed, a change-speed and forward and reverse gear controller, driver's brake valve, starter push-buttons, deadman's pedal, and the necessary service light switches, engine tachometer, and indicator lamps. As soon as the master key is inserted and the switch closed it is then possible to start up the engine, and when sufficient air pressure has been obtained the gear lever can be moved to the first gear position. This lever is mechanically interlocked so that it cannot be moved from "off" unless the reverse lever is in "forward" or "reverse." Depressing the start button marked "This Car" energises the engine start and run solenoid and at the same time causes the starter motor to rotate the engine. Full controls for starting the engine on the second car are provided in each driving position. In addition, a starting position is fitted in each engine-room. When operating in multiple unit either engine and transmission can be readily isolated by simply withdrawing a multi-point plug in the engine-room which carries all the electrical control circuits from the body to the power bogie.

The heating of the car is carried out by means of Clayton Dewandre heater units utilising hot water drawn from the engine cooling water system.

All the diesel engines, power, and carrying bogies and auxiliary subframes are being built at the works of the Vulcan Foundry, Ltd., Newton-le-Willows, the main contractors, who have also carried out the complete erection and testing. The bodies have been built at the Preston Works of the English Electric Company. The whole of the contract is under the inspection of Mr. R. J. Harvey, Consulting Engineer to the New Zealand Government Railways. A number of photographs are reproduced herewith.

DRIVER'S CONTROLS

INTERIOR OF CAR

Distribution of Steel Scheme

WHEN the first edition of the Steel Distribution Scheme was introduced five months ago it was stated that there would necessarily be a trial period, and the experience gained during that time would enable adjustments to be made for the more practical working of the scheme. These, together with provisions to deal with certain developments that have taken place, have now been incorporated in a revised simplified edition.

The use of Department symbols, period numbers, and Iron and Steel Control licences is retained. Symbols, which can only be authorised by a Government Department, and period numbers, with tonnages, must be quoted by all consumers of steel when placing orders with finished steel manufacturers. The symbol indicates which Government Department is responsible for an order, and the period number indicates the time during which the steel should be supplied. The Department contract or reference number will, in the new scheme, be automatically included in an authorisation form which will be signed on behalf of the Department by the officer responsible for placing the order. A similar authorisation form will be used by the contractor in dealing with sub-contractors.

IRON AND STEEL CONTROL LICENCES

Where there is no direct authorisation from a Government Department, a licence (which automatically includes a Board of Trade symbol) from the Iron and Steel Control is necessary. This, with the licence number, must then be quoted instead of the Department authorisation referred to above. Licences authorising the purchase of finished steel will be issued by the Iron and Steel Control for home civilian trade, direct export trade, and stockholding merchants (or to replenish stock for home civilian trade and direct export), and for repairs and maintenance in certain cases.

A manufacturer who uses stock for the home civilian trade and for direct export or a stockholding merchant cannot replenish stock without an Iron and Steel Control licence. Supplies to stockholding merchants for stock are intended primarily for sale only for essential purposes for home civilian trade, and it is expected that merchants will co-operate in this regard.

SUPPLIES FOR BUILDING PURPOSES

Contractors and their suppliers who have obtained authority from a customer to quote a symbol, authorisation number, and period number to acquire constructional steel, will note that this authority covers the acquisition only of constructional steel, and not the securing of the steel necessary to carry out the job. Supplies of finished steel for the stock of a structural engineer will be authorised only by Iron and Steel Control licence, and will in general be restricted to a maximum of 50 tons per month. Applications to acquire the steel from mills or a stockholding merchant must be submitted to the Iron and Steel Control on Form S.W. In the case of steelwork other than that for inclusion in a building the raw material may be obtained from mills on the authority of a symbol, &c., without the necessity of the manufacturer or fabricator obtaining a licence from the Control.

Private enterprise works of building or civil engineering construction, where the estimated cost exceeds £500, require a licence from the Commissioner of Works under the Defence (General) Regulation 56A, and application to use the "O.W." symbol for structural steelwork or other finished steel should be made to the local licensing officer of the Office of Works by whom the licence was issued.

HOME CIVILIAN AND DIRECT EXPORT TRADE

No licence is required to purchase articles wholly or partly made from finished steel, but any manufacturer of such articles for the home civilian trade or direct export trade making a direct purchase of finished steel from a producer must first obtain a licence from the Control.

Applications for licences must be made to the Iron and Steel Control by the person desiring to acquire the finished steel, except where the finished steel is required to fulfil a contract, in which case the main contractor must apply for a licence to cover his own requirements and those of any sub-contractors. Unless this provision is strictly observed, contractors may subsequently find that finished steel required for a particular contract has been authorised in part and refused in part.

INDIRECT EXPORT TRADE

In the case of indirect export, as, for example, steel for sparking plugs, members of an Export Group should apply to the Group Secretary, who will obtain the necessary authority from the Board of Trade.

REPLACEMENT OF STEEL

A contractor or sub-contractor using finished steel from his own stock to fulfil authorised orders may replenish such stock by quoting Department symbols, &c., on each order. In the case of a relatively small tonnage used to fulfil a large number of orders, it will not be necessary to furnish this detailed information. The contractor must certify that he has obtained the necessary authorities, and, if asked to do so, give details to the Iron and Steel Control.

Finished steel acquired under licence must be used for the purpose specified in the application.

A booklet, entitled "Distribution of Steel Supplies," is now being published, describing the revised scheme in detail. Application should be made to the Registry, Iron and Steel Control, Tothill Street, London, S.W.1. It is divided into six sections :—

(*a*) General.
(*b*) Placing of orders for finished steel.
(*c*) Contracts placed by or for Government Departments.
(*d*) Purposes not being Government contracts.

(*e*) Purposes covered by Iron and Steel Control licences.

(*f*) Supplies for building purposes.

There are five appendices to the booklet defining the finished steel products covered; the Departments and relative services brought under the scheme; forms of authorisation; naming local reconstruction panels who are responsible for finished steel supplies for air raid emergency repairs, setting out maximum tonnage limits and values, and area liaison officers.

The delivery periods and numbers are as follows :—

January 1st to March 31st	I
April 1st to June 30th	II
July 1st to September 30th	III
October 1st to December 31st	IV

A list of the Departments with their respective symbols is given below :—

H.O., Home Office; A.R.P., Ministry of Home Security; A.D., Admiralty (Bath); AD.M., Admiralty (S.W.1); W.O., War Office; M.S., Ministry of Supply (Adelphi); M.S. (8), Ministry of Supply (Machine Tool Control, S.W.1); AM., Air Ministry; M.A.P., Ministry of Aircraft Production; S.D. (1), Department of Health for Scotland; S.D. (2), Scottish Education Department; S.D. (3), Scottish Home Office; S.D. (4), Department of Agriculture for Scotland; B.T. (1), Board of Trade (Gas Administration Department, S.W.1); B.T. (2); B.T. (4), Board of Trade (Great George Street, S.W.1); B.T. (5); B.E., Board of Education and University Grants Committee; M.H., Ministry of Health; A.F., Ministry of Agriculture and Fisheries; M.T., Ministry of Transport; M.F., Ministry of Food; O.W., Office of Works; P.O., General Post Office; M.D., Mines Department; P.D., Petroleum Department; E.C., Electricity Commissioners; N.I., Ministry of Commerce (Northern Ireland); A.P., Local Reconstruction Panels (Ministry of Aircraft Production).

The Use of Symbols in Steel Distribution

The working of the Iron and Steel Control has been greatly facilitated and the allocation of steel supplies simplified by the use of a symbol for every steel job. Authority to use a symbol, which can only be obtained in writing from a Government Department, automatically entitles a person to obtain a certain quantity of steel. No symbol is required in the case of iron, which is rationed through the control of pig iron.

This system covers every possible use of steel, whether the replacement of pins or steel for the construction of a battleship.

By arrangement with the Iron and Steel Control, each Government Department is allotted a fixed quota or ration of finished steel. The right to use a Department's symbol means, in effect, the right to use a portion of that Department's ration of steel.

For example, the Board of Trade is responsible for the steel needed for a considerable number of civilian requirements; consequently the symbol "B.T." must be used in the case of steel for bicycles, steel brads for boots and shoes, and so on. As the Board of Trade is also responsible for exports, here, too, the "B.T." symbol is necessary.

As symbols can only be used following written confirmation by the Department concerned, no errors can occur if the main contractor secures this authority when obtaining the necessary allocation of steel. This applies in all cases, however, large or small as the order may be. Similarly, sub-contractors should obtain a symbol in writing from the main contractor for their part of a job, except in the case of purchases from a stockholding merchant.

Producers, consumers, or contractors who are in any doubt concerning the further use of any symbol should get in touch with the Department with whom they have been dealing. Alternatively, they should communicate with the Iron and Steel Control. Here civil requirements needing the Board of Trade symbols are dealt with. On an average, between four and five thousand such applications are authorised weekly.

The symbols of the various Government Departments are given above.

Introducing the Iron and Steel Control's simplified scheme for distribution of steel, Colonel J. J. Llewellin (Parliamentary Secretary, Ministry of Aircraft Production), Chairman, Raw Materials Priority Committee, refers to it as "the only method of ensuring that the best use is made in the national interest of the available steel supplies. . . . By adhering rigidly to the provisions, purchasers of finished steel will be assured, so far as is practicable in war time, of their supplies at the right time."

A revised edition of the Control's explanatory booklet is being published, and contains precise directions covering every class of steel user. The essence of the scheme consists of obtaining from the Government Department concerned authority to use a symbol distinguishing the exact purpose of a particular job.

Having obtained this authority in respect of a given quantity of finished steel, the contractor or consumer places his order with the steel works or merchant in the ordinary way, quoting the Department symbol, contract or reference number, and the period in which delivery is required.

The quantity of steel supplied against such orders is then debited against the quota of steel allotted to the authorising Department. In this way the total quantity of steel which can be produced, quarter by quarter, is distributed according to the degree of urgency in each case, while at the same time avoiding the bottle-necks which would result from indiscriminate ordering in excess of available production.

Commenting on the revised scheme, an official of the Iron and Steel Control has stated: "Experience gained during the last five months has shown us where the original rules could be tightened up so as to ensure that the most essential requirements are not prejudiced as a result of occasional supplies for non-essential purposes not coming under control. The agreed allocations for each Government Department, including in many cases a fixed quota for the principal civilian trades using steel, will enable manufacturers to establish, and it is hoped adhere to, definite production programmes. This will be of special importance to manufacturers interested in the export trade."

Supplies of finished steel for building purposes are now subject to special regulations, in addition to the scheme for licensing constructional and building work announced by the Office of Works. After such licence has been obtained, authority must be sought, both for the acquisition of structural steelwork and, by the structural engineer, for acquiring the corresponding finished steel from the steel works.

The structural engineer who keeps a stock of finished steel for sale as such, and stockholding merchants, will be supplied for essential purposes only under an Iron and Steel Control licence.

Transformers for Resistance Welding Machines

THE manufacture of resistance welding machine transformers is a somewhat specialised business. Usually they are built into the body of the machine to make a neat and self-contained unit, and to keep

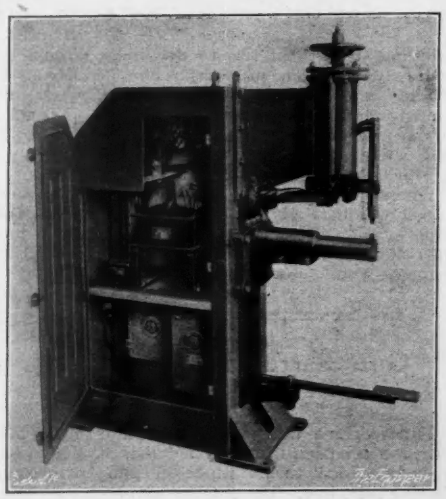


FIG. 1—20-KVA SPOT WELDING MACHINE

the length of heavy current connections between the transformer winding and welding electrodes as short as possible, an arrangement that generally makes the use of oil-immersed transformers impracticable and dry transformers are employed.

For outputs up to about 30 kVA naturally cooled

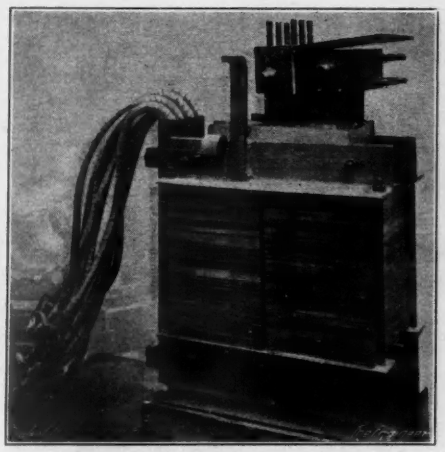


FIG. 2—ASSEMBLED TRANSFORMER

dry type welding transformers present no special problems, and this type has been standardised by the Metropolitan-Vickers Electrical Company for spot and flash welders up to this capacity. In Fig. 1 is shown a 20-kVA spot welding machine with the inspection doors open, where the transformer is to be seen in the upper part of the body behind the fixed electrode.

But for machines of greater output, having a sustained and onerous duty cycle, the question of cooling dry type welding transformers becomes one of increasing difficulty, and transformers have been designed in which water cooling is chiefly employed. In these transformers the secondary coils are wound from rectangular section copper tube, through which the cooling water is circulated, either in series or in

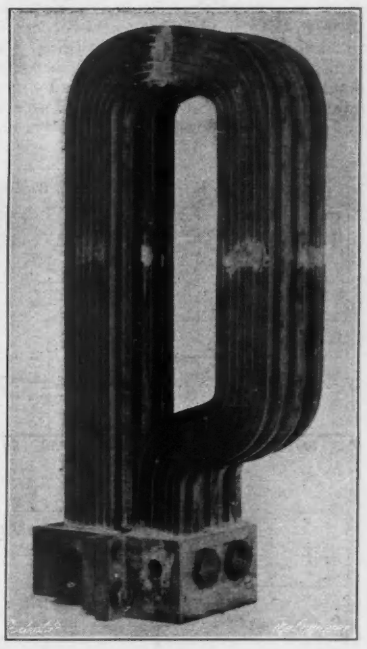


FIG. 3—WATER-COOLED SECONDARY WINDING

parallel with the water cooling of the welding electrodes of the machine.

In Fig. 3 is shown the secondary winding of a transformer of this kind, the secondary winding consisting of a number of tubular coils connected in parallel to a pair of castings which serve the dual purpose of headers for cooling the water supply and of secondary bus-bar terminals to receive the electrode connections.

With this type of coil a very high current density is possible, and the rating is usually determined by consideration of permissible voltage drop rather than by

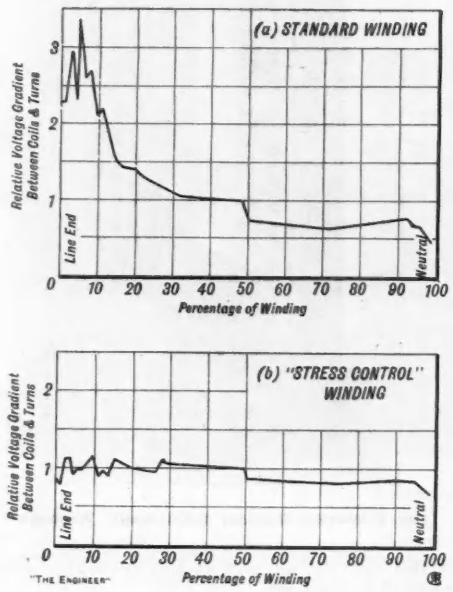
FIG. 4—WELDING MACHINE IN OPERATION

heating. The assembled transformer ready for mounting inside the welding machine is shown in Fig. 2, whilst a machine incorporating such a transformer in operation is shown in Fig. 4.

Changes of secondary voltage as may be required for different jobs to be welded are provided by means of tappings on the primary winding. Variation down to about 50 per cent. of the maximum voltage is obtained by means of a straightforward tapped extension of the primary winding, but by the addition of a series parallel section reduction to about 33 per cent. of maximum secondary voltage is possible. The tapping and series-parallel connections are changed by means of off-circuit selector switches mounted in a convenient position on the welding machine.

Lightning-Proof Transformers

HIGH-VOLTAGE surges on transmission lines attributable to lightning and other disturbances set up serious stresses in transformer windings. In general, the damage is caused by local concentrations of stress in certain parts of the windings. Operating experience has indicated clearly the relatively weak points of a normal winding, but reinforcing the insulation at these points is not in itself a solution to the problem. Experience has shown that frequently the reinforcement is ineffective, and instances have occurred of consequent failures in the adjacent ordinary insulation. It is possible to distribute the surge voltage more uniformly throughout the windings by means of suitably disposed electrostatic shields. The essential requirement is not, however, necessarily uniform



Typical curves of axial stresses taken from oscillograph measurements on 5000 kVA, 3-phase 33 kV transformers with an 0·2/40 micro-second incident impulse.

FIG. 1—SURGE STRESS DISTRIBUTION IN TRANSFORMER WINDINGS

voltage distribution, but uniform voltage gradients or stresses. It does not matter whether the voltages between turns and coils are equal throughout the winding, so long as the insulation is in proportion and is appropriately increased in those places where the maximum voltages are relatively high. The voltage distribution is largely determined by the insulation between turns and coils, and this same insulation, of course, determines the electric strength. It has been found possible to so co-ordinate these values that the surge coil and turn voltages, whilst not necessarily uniform throughout the winding, are in proportion to the insulation strength at every point, and result in substantially uniform stresses. The use of the insulation actually providing the electrical strength to control the corresponding electrical stresses has given rise to the term "stress control" as the title of a new design of winding introduced by Ferranti Ltd.

Quantitative results are shown in Fig. 1. Curve *a* shows the stress distribution in an ordinary transformer winding, whilst curve *b* shows the corresponding values for the "stress-control" design. These values are taken from cathode ray oscillograph measurements on a 5000-kVA, three-phase, 33-kV transformer, with a 0·2/40 micro-second surge. Transformers embodying the new "stress-control" design have recently been built and put into service, and Fig. 2 shows one of these transformers for 20,000 kVA, 132,000 volts. The general construction follows the usual practice, whilst the mechanical and thermal characteristics are unchanged. The "stress-control" design gives increases in lightning strength of two to five times normal for little extra cost. The results thus obtained have been checked and substantiated by full-scale tests on windings of all types, whilst the practical application of the principle has been proved by surge tests to destruction on transformers varying from 25 kVA at 11,000 volts to 60,000 kVA at 132,000 volts.

Whilst it is not yet possible to claim that any transformer windings are absolutely lightning-proof, this large increase in surge strength will greatly reduce the risk of failure due to lightning surges, even under the most severe operating conditions.

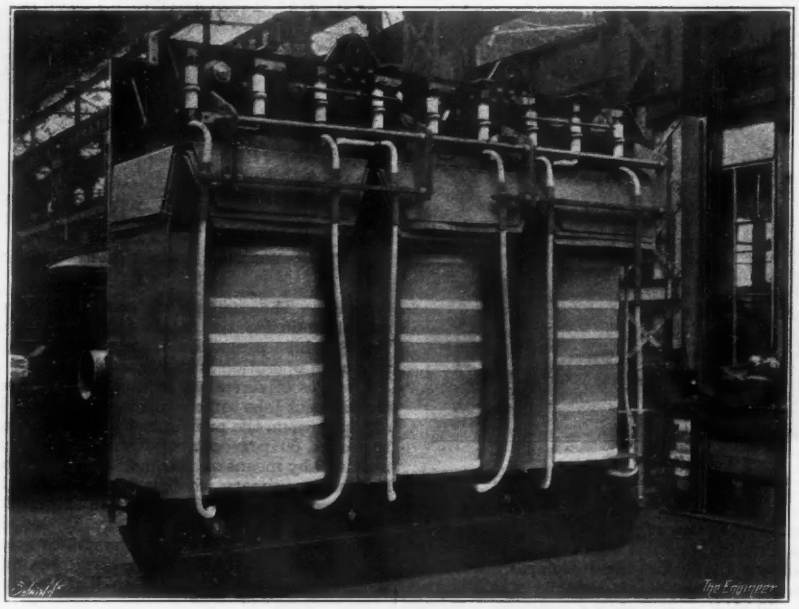
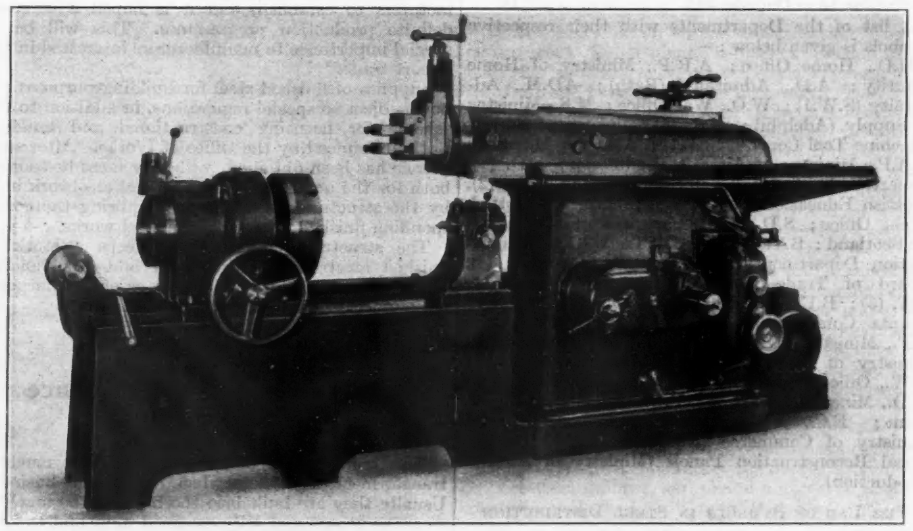


FIG. 2—20,000-KVA, 132-KV "STRESS CONTROL" TRANSFORMER

Gun Barrel Spline Shaping Machine

THE machine illustrated herewith is one which Ormerod Shapers, Ltd., Hebden Bridge, Yorks, has recently added to its range of gun barrel splin shaping machines. The machine has been developed from the firm's standard spline shaping machine, and is capable of dealing with barrels up to 6½in. diameter. It will be seen from the illustration that it is mounted on an extended bed, carrying the table top, on which are mounted a fixed tailstock member and a hollow spindle dividing headstock. This headstock is adjustable on the guide ways by means of a screw. After adjusting the headstock at the required position the barrel is gripped in the chuck which is mounted on the forged steel spindle of the dividing head. A six speed feed box gives a rotary motion to the spindle through spiral gearing, a large diameter phosphor bronze worm wheel, and a high tensile steel worm, which run in an oil bath. Provision is incorporated for the elimination of backlash.

The spindle may also be rotated rapidly by hand by means of a large diameter hand wheel mounted on the front of the headstock. A hardened steel dividing plate is mounted on the rear of the spindle, and with it a spring-loaded plunger engages for indexing the interruptions. A tool-setting device



GUN BARREL SPLINE SHAPING MACHINE

ensures that the tools are set exactly on the centre line of the workpiece, whilst a roller bracket mounted on the end of the bed facilitates the easy loading of the gun barrel.

The machine is arranged for a self-contained motor drive, the power being transmitted through vee ropes and friction clutch to the nine-speed gear-box. A brake is interconnected with the clutch-operating mechanism, enabling the machine to be stopped in any desired position. Lubrication is effected under pressure from a pump, fitted with an inlet filter and pressure gauge.

The length of stroke obtainable on this machine is 26in., and a direct reading dial indicates the length of stroke in use. The machine weighs approximately 85 cwt., and occupies a floor space measuring 12ft. 6in. by 4ft. 6in.

BRITISH STANDARDS INSTITUTION

All British Standard Specifications can be obtained from the Publications Department of the Institution at 28, Victoria Street, London, S.W.1. The price of each specification is 2s. 3d. post free, unless otherwise stated.

BOLTED FLAMEPROOF CABLE COUPLERS

B.S. 912—1940. This specification forms one of a series of specifications for electrical apparatus for use in mines, the cable couplers being capable of being used as detachable dividing boxes. They are so designed as to enable two or more cables of various descriptions to be coupled together or to enable a cable to be coupled to apparatus. Two types of couplers are covered, *i.e.*, the link type and the contact pin and contact tube type. In either type it is intended that the two or more units which comprise a coupler shall be attached to one another by bolts, studs, or screws, and so constructed as to permit subsequent detachment of the units without disturbing the attachment of the cable thereto.

The specification covers construction, mechanical strength, flameproof enclosure, insulation, case, self-alignment, contact pins, contact tubes, and links, and it also gives tables of electrical clearances and standard voltage and current ratings. High-voltage tests are also included.

BOOKS OF REFERENCE

A New Dictionary of Chemistry. Edited by Stephen Miall. London: Longmans, Green and Co. 1940. Price 42s.—This is an exceptional dictionary, and a very commendable one. It has been compiled under the editorship of the Editor of *Chemistry and Industry* by a number of experts, and is notable for the skilful condensation which has made it possible to cover a large subject in one volume. To anyone who wants broad statements rather than details, it will be welcome. It bears to larger dictionaries of chemistry the same relationship that the Concise Oxford Dictionary bears to the O.E.D. The exceptional character to which we have referred is imparted by two things, first, biographical notes about eminent chemists, and, secondly, about drugs and their uses.

Markets, Notes and News

The prices quoted herein relate to bulk quantities. Unless otherwise specified home trade quotations are delivered f.o.t. Export quantities are f.o.b. steamer.

Our Imports in August

The Board of Trade Returns for August in their abbreviated war-time form show that the imports during that month considerably increased in value when compared with the corresponding month of 1939. The total was £95,019,856, an increase over August last year of £13,946,737. The imports of iron ore and scrap in August totalled £1,664,883 a rise of £337,615 compared with August, 1939. The imports of non-metalliferous ores and scrap amounted in value to £2,845,693, an increase of £1,080,010 over the value of the imports in August, 1939. Iron and steel and manufactures thereof were imported to the total value of £5,364,803, being a rise of £3,241,240 over the August, 1939, imports, whilst imports of non-ferrous metals and manufactures thereof reached £6,288,349, which was £2,975,488 higher than the total for August last year. Cutlery, hardware, implements and instruments were imported to the value of £208,094, or £381,740 less than in the corresponding period of 1939; whilst imports of electrical goods and apparatus at £193,671 were also lower by £63,056 than the total in August, 1939. The value of machinery imported in August reached £2,673,472, which was an increase over the total for the corresponding month of 1939 of £394,079. There was a considerable rise in the value of vehicles imported, including locomotives, ships, and aircraft, which reached £3,089,370, an increase of £2,726,372 over the figure for last year. The total imports for the eight months ending August 31st, 1940, were valued at £792,927,723, compared with £605,949,432 for the corresponding period of 1939, an increase of £18,978,291.

British Exports

The total value of our exports during August amounted to £32,554,729, a drop of £4,522,245 when compared with the value of the exports in August last year. Exports of coal reached £1,218,979, which was a decline of £1,751,663 from the figure for August, 1939. The value of the exports of scrap, as might have been expected, has shrunk to £146 in August, which was £16,553 less than for August, 1939. The exports of non-ferrous metalliferous ores and scrap were valued at £15,458, or £172,800 less than the value for the corresponding period of last year. The exports of iron and steel and manufactures thereof totalled in value £2,403,056, or £378,242 below the value of these exports in August last year. The exports of non-ferrous metals and manufactures thereof were valued at £926,494, or only £13,825 below those for August, 1939. Exports of cutlery, hardware, implements, and instruments were valued at £857,199, which was £130,456 more than for the corresponding period of last year. Electrical goods and apparatus, which were exported to the value of £1,299,417, were £364,322 more than in August, 1939. Machinery was exported to the value of £3,332,978, a decline of £629,593 from the value of goods in this category exported in August last year. The value of vehicles exported in August, including locomotives, ships, and aircraft, reached £1,921,268, or £780,760 below the value of similar exports in August, 1939. The total exports for the eight months ending August 31st, 1940, reached a value of £312,630,969, compared with £313,636,853 for the same period of 1939, a decline of £4,522,245.

The Pig Iron Market

Whilst the general situation in the pig iron market is satisfactory, the increasing demand for all descriptions has necessitated a still tighter control over the distribution of iron to firms engaged upon what is regarded as non-essential work. This control is likely to be exercised during the fourth quarter of the year, but firms employed upon war work are receiving their full requirements. The production of pig iron is on a heavy scale and an expansion of output has been made possible by the larger supplies of raw materials. Considerable imports of rubio ore have enabled the producers to increase the production of hematite iron and the situation in this department has become easier. Consumption, however, is still in excess of the output, but users are obtaining supplies more freely. An expansion in the use of scrap has also helped the general situation and most consumers have now considerable stocks in hand. Practically all kinds of scrap seem to be in good supply and a national survey is to be undertaken of future resources in scrap metal. The foundry trades on the North-East Coast are obtaining a fair proportion of their requirements from the local makers of pig iron, but large quantities are still being brought from the Midlands. There has been no change in the official prices, which are 120s. for No. 3 quality, d/d Teesside, and 122s., d/d North-Eastern area, with 5s. per ton loyalty rebate. The nominal quotation for No. 3 foundry iron for export is unchanged at £6, f.o.b. In the Midlands there is a great demand for foundry qualities from the heavy engineering foundries, and machine toolmakers, who for the most part are employed upon Government work. The general view is that the demand from this source will increase during the next few months, and there is a possibility that a tightness will develop in some grades principally required by these industries. There is still stringency in the supply of low-phosphoric iron, but the producers lately have been obtaining better supplies of ores suitable for the manufacture of this class and of hematite, and it is understood that imports of the required qualities of iron have been arranged. There has been an increase in the amount of high-phosphoric foundry iron produced and the light castings industry generally seems better employed. In Scotland the position has improved as a result of larger supplies of raw material and a consequent increase in the production of pig iron. The official price of No. 3 foundry is 115s. 6d., f.o.t. furnaces. Midland iron is brought into Scotland for the use of the light castings foundries who are still not fully occupied, and are not likely to be until there is more activity in house building. Large quantities of basic iron are going to the steel works. The output of this quality is particularly heavy and it is supplemented by importations from America.

Scotland and the North

The Scottish heavy steel works have a large tonnage of orders on their books and are working at capacity. Fortunately, the supplies of raw materials, including scrap, are reaching the works with regularity and in good volume. As a result it is possible to maintain a steady rate of operations. The demand is principally on Government account and in connection with the war effort. Priority orders also take up a large part of the output, but there is little surplus material available for ordinary commercial users. The shipbuilding industry is busily employed and is absorbing large tonnages of ship-plates and sections. Larger quantities of plates would be welcome, but the stringency in this department does not seem so sharp as it was a few weeks ago. The engineering works in Scotland are fully employed and marine engineers are particularly busy. Large tonnages of steel of various descriptions are passing into consumption through these channels. The demand for special steels seems to have increased of late and large quantities are wanted by engineers engaged in producing various sorts of war vehicles. The tube works in Scotland are working full time and there is a heavy call for practically all sizes. The home output of semi-finished steel is on a heavy scale, but is insufficient alone to meet the requirements of the re-rollers. Large importations of American semis, however, have helped to relieve the situation, and it is assumed that the re-rolling industry will be provided for in future without difficulty. There has been a good demand for bar iron of all categories. The mills are busily employed and have enough orders in hand to keep them occupied for some time. The Lancashire steel market is as busy as it has been for some months. Pressure for supplies, in fact, seems to be growing. The constructional engineering firms are not so busy as they were a short time ago, and the consequent decline in the pressure for supplies on angles, joists, &c., has been welcomed by the steel makers, as it has enabled them to deal with some of their arrears. One of the features of the market is the active demand for bright steel bars. The heavy steel works report a strong demand for the larger-diameter bars. Business in nickel and alloy steels is on an active scale. On the North-West Coast the works are fully employed and are turning out large quantities of rails, sections, bars and hoops.

The Midlands and South Wales

Consumers in the Midlands continue to press hard for deliveries against contracts, and notwithstanding their great efforts to keep abreast of the demand the steel works are in many cases falling into arrears. New business continues to come in enormous volume and production is being pressed to the utmost. The position of the re-rollers, however, has considerably improved during the past week or two as a result of the imports of large tonnages of semis. The output of light sections, bars, and strip has increased, and many of the mills are now overtaking arrears in deliveries against contracts. At the end of this month Period 3 of the Delivery Scheme comes to an end, and there will be considerable tonnages of steel outstanding. Consumers, however, will have to obtain from the Government Departments concerned authority for any balance to be carried forward into Period 4. The heavy steel works, as well as the re-rollers, have well-filled order books for the last quarter of the year, and would be relieved by the cancellation of some of the contracts on their books. The demand for sections, heavy and light, is undiminished, and the quantities called for are taxing the resources of the works. Many of the Midland constructional firms are not so fully employed as was the case a few weeks ago; but this does not seem to have affected the demand for joists and sections, and consumers' requirements of the lighter sections appear as important as at any time since the war began. The demand for steel for munitions continues to increase and the steel works have now to deal with a heavy call for shell steel and special steels for various war purposes. Business in small bars and re-rollers' sections is maintained at recent levels; but fortunately, with better supplies of raw material, the re-rolling works are more able to cope with the demand. The situation in the bar iron industry is now satisfactory and large outputs are being obtained. In fact, some of the works are reluctant to accept fresh contracts in view of the congested state of their order books. The iron and steel industry in South Wales is operating at capacity and outputs are maintained at a high level. Large tonnages of heavy finished steel are passing to the engineering and shipbuilding industries, whilst the production of tin-plates is on a good scale. The industry, however, is experiencing a rather quieter demand, largely because of the closing of several export markets which have been overrun by the Germans. Supplies of sheet and tin-plate bars, however, appear to have improved somewhat lately, and the tin-plate and sheet mills are busy.

Copper and Tin

In Great Britain the chief feature of the market is the excessive demand for copper for war purposes, and it is to the credit of the Control that supplies are forthcoming for all consumers engaged upon essential work. There is also a certain amount of copper available for industries making articles for export, and licences are granted with a fair amount of freedom. The American market has developed great activity and as a consequence prices have advanced. The domestic quotation is now 12 c. for both the primary producers and the customs smelters. The export quotation, however, remains at 9·90 c. The domestic demand is principally due to the American rearmament programme, and it may be expected to develop even greater strength. Quiet conditions rule in the export market, but Japan has been inquiring for fair quantities. It is stated that the sales for the first twenty-four days of September totalled 211,471 short tons. This exceeds any previous record. . . . Prices in the tin market have been firm, largely because the smelters have shown less inclination to sell. The demand also has been quiet. In the East the turnover has been on a considerable scale, principally owing to American buying. In the middle of this week prices showed a slightly easier tendency, but the undertone remained firm. Reports that the British Government intends to accumulate a war reserve of this metal similar to that taken up by the American Government are not regarded seriously in this country.

Lead and Spelter

The lead-consuming trades are, without exception, extremely busy, chiefly upon Government work, and large quantities of lead continue to pass into consumption. Supplies, however, are adequate to fill all the requirements of the war industries. The cable and battery makers in particular are extremely busy upon Government work. Lead, however, is obtainable by firms engaged upon the manufacture of exportable products. In the United States the market has developed considerable strength, and prices have become steady at 5 c., New York. Stocks in the producers' hands are not large, and with the prospect of the demand increasing as a result of the American rearmament plans, it seems likely that firm conditions will continue to rule in this market. . . . The position of spelter in Great Britain is satisfactory, and there is a fully adequate supply for the British war industries. Consumption, however, is on a large scale, and there does not seem much surplus for ordinary commercial purposes. The galvanisers, however, appear to be taking larger quantities and are reported to be getting busier. In the United States the position is reported to have become rather tight, and the demand for rearmament has definitely affected the market. The quotation in the United States has advanced to 7¼ c., East St. Louis. Figures issued by the American Bureau of Metal Statistics give the imports of spelter into the United States during July as 14,575 tons. This was much above the usual scale of imports, as was the total for the first seven months of this year at 75,571 tons.

Non-ferrous Metal Prices

The official statement issued by the London Metal Exchange for September indicates a considerable drop in the average price of tin. The settlement price dropped by £11 3s. 4d., compared with the average for the previous month; whilst cash tin was £11 5s. 6d. and three months metal £8 16s. 6d. lower in September than in August. The statement, which includes the official maximum prices for copper, lead, and spelter, is as follows:—

Standard tin	Cash (mean)	£257	6 10⅝
	Three months (mean) ...	£254	4 7½
	Settlement	£251	7 4½

The following prices for copper, lead, and spelter are the maximum prices fixed by the Controller of Non-ferrous Metals:—

	£	s.	d.		
Standard copper	—				
Electrolytic copper ...	62	0	0	delivered buyers' premises	
Electrolytic wire bars ...	62	0	0	,,	,,
Best selected copper ...	60	10	0	,,	,,
Lead, good soft pig (foreign)	25	0	0	,,	,, (duty paid)
Spelter, G.O.B. (foreign)	25	15	0	,,	,, (duty paid)

CATALOGUES

BRITISH INSULATED CABLES, Ltd., Prescot, Lancs.—Leaflet on C.M.A. fire-resisting insulated cables.

RADIATION, Ltd., Palatine Works, Warrington.—Booklet entitled "Planning the Canteen in War Time."

HADFIELDS, Ltd., East Hecla Works, Sheffield.—Leaflet No. 444 on elevator, conveyor, and creeper links.

TINTOMETER, Ltd., Milford, Salisbury.—Booklet on interchangeable discs available for Lovibond comparators.

FIELDING AND PLATT, Ltd., Atlas Works, Gloucester.—Booklet describing many of the firm's products, especially presses.

INCANDESCENT HEAT COMPANY, Ltd., Cornwall Road, Smethwick, Birmingham.—Booklet on furnaces for the railway industry.

BARIMAR, Ltd., 14–18, Lamb's Conduit Street, W.C.1.—Booklet on "Scientific Welding Repairs to Industrial Machinery."

COCHRAN AND CO., ANNAN, Ltd.—Leaflets 60 F and 62 F, dealing with Cochran boilers and "Sinuflo" gas-fired boilers respectively.

MANGANESE BRONZE AND BRASS COMPANY, Ltd., Handford Works, Ipswich.—Schedule of English and metric sizes of Oilite bearings.

W. EDWARDS AND CO. (LONDON), Ltd., Allendale Works, Southwell Road, S.E.5.—Card describing "Apiezon" waxes, greases, cements, &c.

SPUNGROOVE, Ltd., 7, Princes Street, Westminster, S.W.1.—Booklet containing technical data on "Spungroove" high-tensile reinforcement fabric.

SILENTBLOC, Ltd., Victoria Gardens, Ladbroke Road, Notting Hill Gate, W.11.—Catalogue of anti-vibration mountings designed for special applications.

HOLMSIDE AND SOUTH MOOR COLLIERIES, Ltd., South Moor, Stanley, Co. Durham.—Booklet on Witherite (natural barium carbonate) and its industrial uses.

CONSOLIDATED PNEUMATIC TOOL COMPANY, Ltd., 232, Dawes Road, S.W.6.—Catalogue of pneumatic, universal electric and "Hicycle" electric tools for the aircraft industry.

CORRUGATED PACKING AND SHEET METAL COMPANY, Ltd., Wolseley Street, Gateshead-on-Tyne.—Catalogue giving details of joints, washers, shims and gaskets in all materials.

Notes and Memoranda

Rail and Road

S.I.R. Insulated Vans.—It is stated that the South Indian Railway has built experimentally a new type of insulated van for service on fast broad-gauge passenger trains in connection with the transport of perishable goods. The van has a capacity of 9 tons and is divided into three insulated compartments, each having a separate ice container.

Gas-Generator Locomotive.—It is reported from Kiev that two workers of the engine service of the Soviet South Western Railway, Mr. Emelyanov and Mr. Shimanovich, in conjunction with engineers of the Kiev Mechanical Works, Taubin, Lirner and Skrolevetcky, have constructed a new gas generator for locomotives to work on local fuel.

Coal for Egypt.—In spite of Italian operations, the Egyptian State Railways continue to get Welsh coal delivered to Alexandria. Ships carrying about 8200 tons recently arrived from Great Britain and others were expected shortly. The Egyptian Railways had requested the British Authorities to grant special facilities for the shipment of this coal, as other sources of supply had been stopped by the war.

Tyre Reconstruction.—British tyre manufacturers have been requested by the voluntary control panel of the rubber industry to co-operate in a plan to economise the importation of raw materials and secure relief to valuable shipping space. Under this plan the manufacturers, as a war-time measure, are inviting all users of pneumatic tyres to return them, when removed from cars or commercial vehicles, to the original manufacturer through the trade from whom the user normally buys his tyres. All used tyres in suitable condition will, at the request of the customer, be reconstructed in the original moulds from which new tyres are produced.

New Railway in Soviet Russia.—It is reported from Khabarovsk that a new branch railway, 240 miles long, to Komsomolsk-on-Amur, has recently been put into operation, linking up Komsomolsk-on-Amur with the Moscow and Vladivostok trunk line. The new railway begins at the Volochayevka Station No. 2, and runs northwards, not far from the channel of the Amur River, cutting across the Smidovich, Kur-Urmiisk, Nanaisk, and Komsomolsk districts. Twenty-three stations, several sidings, a number of bridges, pumps, &c., have been built. The principal station of this new branch railway has been named Lipovko, after the engineer who met a tragic end when surveying the route for this difficult line.

Railway Station Names.—It has now been agreed by the Minister of Transport that railway station names may be displayed more freely than in the past. If they are so situated under the station roof that they cannot be seen and understood from a highway, or from low-flying aircraft, there is no limit to the size of the lettering which may be employed. Lettering which does not exceed 3in. in height may be used in the open provided that it cannot be seen and understood from a highway. Some little time must necessarily elapse before full advantage can be taken of this relaxation. No avoidable delay will, however, be allowed to occur in meeting the convenience of the public to the fullest extent permissible.

Repair Work on the Underground.—Early one morning recently a bridge carrying four of London Transport's railway tracks was damaged by a bomb, putting a section of the track out of service. Reserve buses were rushed to the scene and were ready, when the first trains arrived, to bridge the gap. In the meantime the Board's engineers were meeting on the spot and by 10 a.m. a plan to restore the railway service had been devised and begun. It was decided temporarily to give up two tracks and to divert all traffic to the remaining two tracks. To do this the Board's staff had to shift high-tension cables and entrench them, to build a new cross-over 200ft. long and to reverse the automatic signalling over 2 miles of track. Although work had to be stopped at night because of the black-out, the train service was restored by 6 p.m. next day. Early in the operations an enemy aeroplane swooped over the workers, but they volunteered to carry on under the protection of Home Guards armed with Bren guns.

Air and Water

Greek Ships.—Owing to the continued tension in the Eastern Mediterranean, the Greek Government has decided to refuse permission to Greek owners to sell any of their vessels to any belligerent.

Air Training in Manitoba.—A contract valued at over £80,000 for the erection of hangars and buildings for the service flying training school at Dauphin, Man., has been awarded to a Winnipeg firm under the Commonwealth air training scheme. The first buildings at the Dauphin service flying training school are expected to be completed early in December.

Canadian Canal Traffic.—The Dominion Bureau of Statistics reports that the total freight traffic through the Welland Ship Canal during July amounted to 1,832,326 tons, compared with 1,659,282 tons in July of last year. Freight through the Sault Ste. Marie Canals amounted to 12,842,224 tons, compared with 9,597,596 tons, and through the St. Lawrence Canals 1,122,961 tons, compared with 1,119,143 tons.

American Shipyard Re-opened.—Two building berths at the Sparrow's Point plant of the Bethlehem Shipbuilding Company have recently been reconditioned after lying idle since 1918, and this part of the yard is now equipped with up-to-date machinery. The slipways are each served by two cranes of the rotating jib type, running on tracks and capable of lifting a maximum weight of 22 tons. Welding generators having a total output of 6000 amperes are installed at the head of the berths, the welding capacity of the yard being increased by one-third as a result of this addition. Compressed air lines have also been led to the berths, for the Bethlehem Company uses both riveting and welding in its constructional design.

Mercantile Losses.—For the week ended September 15th, mercantile losses due to enemy action included nine British ships, totalling 29,246 tons; four Allied ships, aggregating 12,575 tons; and three neutral ships, totalling 7379 tons. This makes a total of sixteen ships, totalling 49,200 tons. Both the British and the total losses were below the average for the previous fifty-three weeks. The enemy losses up to September 22nd amount to 1,043,000 tons of German shipping captured, scuttled or sunk, and 291,000 tons of Italian shipping, making a total of 1,334,000 tons. In addition, there are some 33,000 tons of ex-neutral shipping which have been seized and brought under control by the enemy which have also been sunk.

Salvage from Merchant Ships.—The salvage of waste from merchant ships has recently been initiated by the Ministry of Shipping in conjunction with the Ministry of Supply. Many articles usually thrown overboard are worth salving in war-time, as, added together, they form a great quantity of useful material. Such articles are barrels, barrel staves, tins, cans, cases, both wooden and cardboard, paper, paper dunnage, cardboard, worn sacks, metal scrap, such as broken tools, worn fire-bars, timber and bones. All shipowners have been asked to instruct the masters of their ships to preserve such items and keep them separate. This may often be done by using empty flour barrels. Tins can be crushed and bones should, for sanitary reasons, be sprinkled with chloride of lime. It has been arranged that, when a ship arrives in the United Kingdom, the local authority is informed of the material on board to be salved, so that arrangements can be made for its collection. Shipowners have been asked to impress on masters the need for personal supervision of the arrangements, especially during the initial stages of the scheme. Most companies have responded by asking their masters to organise a salvage campaign on board their vessels, so that the merchant navy, like other industries, should add to the indispensable contribution to the war effort which it already makes. The successful working of the scheme is, of course, dependent upon the full co-operation of the port authorities, which, it is hoped, will be forthcoming.

Ships and Aircraft (Transfer Restriction) Act, 1939.—The Minister of Shipping, in exercise of the power conferred upon the Board of Trade by Sub-section 4 of Section 8 of the Ships and Aircraft (Transfer Restriction) Act, 1939, and now vested in him by virtue of the Ministry of Shipping (Transfer of Functions) Order, 1939, has determined, with the approval of his Majesty's Treasury, for a fee amounting to 50 per cent. of the existing fee for recording transfers of ownership, mortgages and transfers of mortgage, subject to a minimum fee of 2s. 6d. up to a maximum of £5, shall be charged in respect of the giving of his sanction under the above-mentioned Act for the transfer of any British ship registered under Part I of the Merchant Shipping Act, 1894, registered in the United Kingdom, Channel Islands, or the Isle of Man, or of any share in such a ship; or the mortgage of any such ship or any share therein of the transfer of any mortgage of such a ship or share, provided that no fees will be charged in respect of the General Sanction dated May 27th, 1940, given by the Minister of Shipping in relation to certain mortages and transfers of mortgages of ships, nor to sanctions to transactions in respect of fishing boats registered only under Part IV of the Merchant Shipping Act, 1894, or under the Sea Fishing Boats (Scotland) Act, 1886, or to unregistered craft. The fee will be charged in respect of any sanction for which application is made on or after October 1st, 1940, and will be payable only if and when the transaction in respect of which the sanction was given is effected.

Miscellanea

The D.E.U.A.—In view of the prevailing conditions, it has been decided not to hold the October meeting of the Diesel Engine Users Association. The paper arranged for this meeting was on "The Dual Fuel Engine," by Mr. J. Jones, and a limited number of advance copies of the paper will be prepared and distributed to members who wish to contribute to a discussion on the subject by correspondence.

New Gas Main in Soviet Daghestan.—A new gas main running from Izberbash to Makhach-Kala has been laid in the Soviet republic of Daghestan. The new main is intended to supply the industrial undertakings of Makhach-Kala with oil gas from the Izberbash oilfields. The Central Gas Administration of the Commissariat of the Oil Industry is planning to extend the exploitation of the Daghestan natural gas deposits. In particular, it is proposed to commence prospecting in the Uytash district, 9½ miles from Makhach-Kala.

Electricity Commission.—The Electricity Commissioners desire us to draw the attention of all electricity undertakers to the following matters arising out of the war emergency. The Central Priority Department has issued a certificate (Vital Work Certificate No. 11) to the effect that work coming under either of the following categories:—Extensions to distribution systems approved by the Commissioners as essential for giving or maintaining supplies to vital factories; or repairs and renewals of generating stations and distribution systems approved by the Commissioners as essential for the maintenance of supplies to vital factories, is vital work for the purpose of paragraph 2 (ii) of the Direction Given by the Minister of Supply dated June 14th, 1940, and headed "Priority of Production." Undertakers who desire such priority for works of the kind covered by the certificate should therefore make application to the Electricity Commissioners for the necessary approval. In addition, attention is directed to an Order made by the Minister of Transport on September 21st, 1940, relaxing the general obligation on electricity undertakers to give and to continue a supply of electricity to any person or for any premises during such period as they are unable to give a normal supply, owing to war damage, either to their own undertaking or to any other undertaking from which they derive, directly or indirectly, a supply of electricity in bulk.

Canada's Gold Production.—The Dominion Bureau of Statistics reports that during May Canada's production of gold rose to 442,521 fine ounces from the preceding month's total of 418,636 ounces. During the first five months of this year, 2,120,765 fine ounces were produced, compared with 2,055,662 for the corresponding period of last year.

Refrigeration by Solar Energy.—The Leningrad Institute of Research in Refrigeration has been carrying out experiments during the last few years, both in Leningrad and in Central Asia, in the use of solar energy for purposes of refrigeration. The results of the experiments have shown that solar energy for refrigeration purposes can be used not only in Central Asia, but also in Moscow. With a solar apparatus having a heating surface of 1 square metre (1·196 square yards) and a special refrigerating machine, the Institute has obtained 6 kilos. (13¼ lb.) of ice per day.

Oil Under the Caspian.—Recent volcanic action in the Caspian Sea has brought additional proof of the existance of oil under the sea bottom. A short time ago employees of the lighthouse on Svinoi Island, situated in the Caspian Sea, 43½ miles from Baku, were alarmed by continuous subterranean rumblings, the investigation of which was undertaken by a commission of the Azerbaijan Branch of the Academy of Sciences of the U.S.S.R. The scientists discovered active gas and mud volcanoes, ejecting fuel gas. Experts are of the opinion that these eruptions testify to the existence of rich petroliferous strata going deep down under the bed of the Caspian Sea.

Personal and Business

Mr. R. O. Patterson has retired from the works managership of Smith, Patterson and Co., Ltd., Blaydon-on-Tyne, having completed forty years' association with the firm.

Canada Ironfoundries.—The Canada Ironfoundries, Ltd., have moved their head office recently from 760, Victoria Square, Montreal, to 921, Sun Life Building, Montreal.

A Canadian Appointment.—Mr. R. W. Garrett has been appointed acting city engineer of London, Ont., for the duration of the war, while Lieut.-Col. W. M. Veitch, city engineer, is on active service. Mr. Garrett was formerly assistant city engineer.

Metropolitan-Vickers Electrical Company, Ltd., informs us that all inquiries and orders relating to instruments, meters, relays, &c., formerly sent to its meter department at 25, Gorst Road, Park Royal Road, London, N.W.10, should in future be addressed to the London head office of the company, 1, Kingsway, London, W.C.2.

Death of a Railway Engineer.—Mr. C. S. Gzowski, chief engineer of construction of the Canadian National Railways, died on September 7th in Montreal. After gaining experience with the C.P.R. Company, he began in 1905 private practice as a consultant, but in 1919 he joined the Canadian National Railways, and in April of that year was appointed special engineer to the vice-president of operation, maintenance and construction. A year later he was appointed assistant to the vice-president of construction, and in 1923 became chief engineer of construction.

Mr. H. Jasper Cox.—We referred recently to the retirement of Mr. H. Jasper Cox from the post of principal surveyor for the Far East of Lloyd's Register. When Mr. Cox went to Japan in 1920 the plans of ships to be given Lloyd's Register's certificate had to be sent to London for approval. But after he became Lloyd's Register's principal surveyor for the Far East all the necessary formalities were completed on the spot. In 1921 direct representation in Lloyd's Register was established through the formation of a National Committee of Lloyd's Register—the result of Mr. Cox's efforts—which Japanese shipowners, shipbuilders and underwriters formed, the Society's work thereafter being carried out under the supervision of a body which had at its disposal Mr. Cox's wide professional experience in shipbuilding.

Forthcoming Engagements

Secretaries of Institutions, Societies, &c., desirous of having notices of meetings inserted in this column, are requested to note that, in order to make sure of its insertion, the necessary information should reach this office on, or before, the morning of the Monday of the week preceding the meetings. In all cases the TIME *and* PLACE *at which the meeting is to be held should be clearly stated.*

Illuminating Engineering Society

Tuesday, October 8th.—Royal Institution, 21, Albemarle Street, W.1. Presidential Address, "The Arc as a Standard of Light." J. T. MacGregor Morris. 2.30 p.m.

Institute of Fuel

Tuesday, October 8th.—Connaught Rooms, Great Queen Street, London, W.C.2. "Some Thoughts on Coke," W. Boon. 2.15 p.m.

Thursday, October 17th.—Connaught Rooms, Great Queen Street, London, W.C.2. Presidential Address, W. M. Selvey. 2.15 p.m.

Institution of Automobile Engineers

Tuesday, October 8th.—Coventry Centre: King's Head Hotel, Coventry. "Bearing Metals and their Suitability for Modern Requirements," M. Melhuish. 7 p.m.

Wednesday, October 9th.—Manchester Centre: The Engineers Club, Manchester. Mr. Melhuish's paper will be repeated. 7.30 p.m.

Newcomen Society

Wednesday, October 9th.—Chartered Institute of Patent Agents, Staple Inn Buildings, W.C.1. "The Evolution of the Sugar Cane Mill," and "Early Use of Steam Power in the Sugar Cane Industry," N. Deerr and A. Brooks. 2.30 p.m.